A MANUAL

OF

PHOTOGRAPHIC MANIPULATION.

A MANUAL

OF

PHOTOGRAPHIC MANIPULATION.

TREATING OF

THE PRACTICE OF THE ART;

AND

ITS VARIOUS APPLICATIONS TO NATURE.

BY

LAKE PRICE.

LONDON:
JOHN CHURCHILL, NEW BURLINGTON STREET.
MDCCCLVIII.

[*The Author reserves to himself the right of translating this work.*]

PRINTED BY J. E. ADLARD, BARTHOLOMEW CLOSE.

THE CITY PUBLIC
LIBRARY

PREFACE.

THE object of the writer of the following pages has been to avoid, as much as possible, all circumlocutory preamble; to condense into the shortest space, and in the most simple form, the information which he has to offer to the reader. At the same time, in a process the nature of which is extreme nicety in many delicate manipulations, and in which the most exact respect for necessary precautions is indispensable to a successful result, he must claim indulgence if he dwells occasionally on what at first sight might appear trifles, but on the observance or non-observance of each of which the perfection of the resulting picture is intimately connected and depends; it being, moreover, extremely difficult, in cases of failure, for the operator to decide at which particular point of the

Preface. manipulation the neglect has happened which may have caused his perplexity.

In contributing his quota to the general stock of knowledge on this interesting art, he may probably recapitulate facts known to those advanced in its practice; which, however, are necessary to be impressed on the less experienced, and without which a work like the present would be incomplete.

If the results of his practice in Photography should smooth some difficulties, and facilitate the progress of the student, the intentions of the writer will be attained.

London; *May* 1*st*, 1858.

CONTENTS.

	Page
INTRODUCTION	1
Discovery and Progress of Photography	7

PART I.

THE PRODUCING AGENTS DESCRIBED.

On Light	11
The Eye and the Camera	21
Lenses	30
Diaphragms	46

PART II.

THE REQUISITE APPARATUS.

The Glass Studio	57
The Operating Room	63
On Cameras	66
Camera Stands	72
Swing Camera Back	74

CONTENTS.

Page

Head Rests 76
On the Glasses 78
Dippers 82
Scales 83
Developing Stand 84
Pneumatic Plate Holder 85
Specific Gravity Bottle . . . . ib.
Glass Bath 86
Wedgewood Trays 87
Developing Glasses, &c. 88
Retort Stand 89
Horn Tongs 90
Glass Bottles . . . . . ib.
Still 92
Spirit Lamp 93
Printing Frames . . . . . ib.
Exciting Tray 94
Focusing Cloth, &c. 95
Test and Filtering Papers 96

PART III.

MANIPULATIONS.

Preparing the Camera 97
To lay the Film 98
Exciting the Film 101
To expose the Film 103
Time of Exposure 104
To develope the Image 107
Appearances of the Image when developed . . 112
Fixing the Image 115
Varnishing the Picture 116
Defects, their Causes and Remedies . . . 119

PART IV.

SUBJECTS; THEIR NATURE AND TREATMENT.

	Page
Portraits	137
Taking a Group of several Figures in the Studio	150
Rustic and Picturesque Figures	157
Instantaneous Pictures	160
Landscapes	166
Architecture	173
Marine Subjects	178
Animals	180
Pathology and Chirurgery	182
Statues, Busts, Bassi Relievi, and Bronzes	183
Still-Life	187
Copying Pictures, Drawings, Prints, &c.	189
Fac-similes of Manuscripts, early printed Books, &c.	194
Stereoscopic Pictures	195
Interiors of Edifices, &c.	203
Astronomical Photography	205
Microscopic Subjects	206

PART V.

PRINTING PROCESSES.

Paper	210
Albumenized Paper	211
Plain salted Paper	214
To excite the Papers	215
To print from the Negative	216
Toning the Proofs	222

PART VI.

SOLUTIONS AND CHEMICALS.

Contents.		Page
	The Nitrate Bath	227
	Nitrate of Silver	233
	Iodide of Potassium	234
	Distilled Water	ib.
	Alcohol	ib.
	Sulphuric Ether	235
	Collodion	236
	The Toning Bath	238
	Chloride of Gold	242
	Chloride of Silver	243
	Developing Solution	ib.
	Pyrogallic Acid	244
	Acetic Acid	ib.
	The Exciting Solution for printing	245
	Fixing Solution for the Film	246
	Fixing Solution (for printing)	247
	Hydrosulphite of Soda	ib.

A MANUAL

OF

PHOTOGRAPHIC MANIPULATION.

INTRODUCTION.

THE feelings of curiosity and astonishment with which the discovery of Photography and its earlier productions were regarded, have now sobered down by our intimate and daily acquaintance with its results in some one or other of the numerous directions in which its powers are applied. Photography;

Still the very fact that it has become a common-place, proves its extreme popularity; and the most indifferent of the pictures of its followers is not without its value in the diffusion of knowledge, the creation of a feeling for Art, and an increased appreciation of the infinite wonders and beauties of Nature, in individuals who, without the facilities which it has given, would probably have remained entirely strangers to such enjoyments. its popularity, and advantages.

INTRODUCT. Its applications to Natural History, Geography, Astronomy, Electricity, and the Microscope, Antiquities, Architecture,

In a multiplicity of ways, Photography has already added, and will increasingly tend to contribute, to the knowledge and happiness of mankind: by its means the aspect of our globe, from the tropics to the poles,—its inhabitants, from the dusky Nubian to the pale Esquimaux, its productions, animal and vegetable, the aspect of its cities, the outline of its mountains, will be made familiar to us.

The traces of those generations long ages ago passed from its surface, who, with the inherent feeling of our kind, have striven to leave to a dim posterity, by their gigantic but decaying efforts, some relic and memento of their passage; all have been or will be brought in intense reality to our very hearths.

Nay, passing even beyond in its career, already have the appearances of the firmament, the minutiæ of the planets, and of our satellite, been noted with unerring accuracy; the mysterious currents of electricity, and the movements of our atmosphere, are by its means exactly registered; the marvels disclosed by the microscope are faultlessly delineated, and in these, as in all directions, we cannot put limits to its scope and powers.

The antiquary and architect are indebted to it for such faithful images of the objects of their pursuit and study as they have never previously

seen,—the mechanist and the engineer may take their compasses and measure the parts of each viaduct, engine, or bastion, which nature's drawing has laid down to scale for them. The artist and the dilettante have seen and will see transcripts of the distant and scattered masterpieces of Raffaelle and Titian, of Velazquez and Murillo, brought together and united for near comparison in their folios; not as mere diluted translations by the hands of others, but with their own touch, feeling, and power.

Introduct. Engineering, and the Fine Arts.

The emigrant and traveller, far from their early home, send mementos from distant climes, of halts under sultry skies, in which, surrounded by strange, swarthy figures, and shaded by the luxuriant vegetation of the tropics, the elephant and camel browsing beside them; those dear to them in distant England see the familiar face from which they may long be separated. Amidst the icy barriers which have been placed to guard the hidden mysteries of the Poles, those who have had the daring to endeavour to penetrate their awful solitudes have made use of Photography to bring away the impress of them.

The Emigrant and Traveller.

From Australian cabin, from Canadian log-hut, come images of faces born on that distant soil, akin in blood, yet strangers to those at home who bear their name,—even the humble artisan and lowly cottar, heretofore deprived from indulgence

Familiar uses.

Introduct. in such natural feelings, may see the mementos of those who are, or have been, dear to them, upon the walls of their modest dwellings.

Historical uses. Posterity, by the agency of Photography, will view the faithful image of our times; the future student, in turning the page of history, may at the same time look on the very skin, into the very eyes, of those, long since mouldered to dust, whose lives and deeds he traces in the text.

Its public importance As this art progresses to perfection, each impressive public ceremonial will be registered and delineated; nay, even the very turmoil of the battle or siege and their varying aspects will be instantly fixed and transferred, with the actors, to the page of history, by an art to which the delineation of thousands of figures or of a blank paper present equal facilities of execution.

in fixing passing events.

Summary. The foregoing are some of the benefits which Photography will confer on art, on science, and mankind, when arrived at its more mature development; and when we reflect how much has been done in the few years which have elapsed since its discovery, we need not despair of further surprising advances; for we must not at all consider that it has attained the limits of its perfection. Much yet remains to be done by all interested in its advancement, and it is to be hoped that their efforts will, in their several departments, be successful.

Anticipation for its future.

To the natural philosopher we must turn for new discoveries in those mysterious combinations of LIGHT, HEAT, and ELECTRICITY, which may advance our knowledge of their united action, and possibly will result in giving us not only form, but colour, in the picture. To the mathematician and optician we look for lenses, in the performance of which the operator may not feel himself fettered and his picture limited in size; or if he increase its dimensions, that want of intensity, weakness of definition, distortion in the proportions of the figure, and shallowness of focal depth, may not result—qualities in which, at present, more perfection is greatly needed, and which advances, if successfully accomplished, will raise the character of the instrument, and enable it to fulfil completely and satisfactorily the uses for which it is intended. To the chemist for those improvements or new combinations in the materials used in the process, which shall considerably abbreviate the time necessary for the production of the image. And, finally, to the artist, for that judicious selection and arrangement, whatever his materials may be—for everything in nature, even to the smallest weed, has beauties and capabilities—that the pictures we shall see may show marks of reflection and intelligence, and conformity to those rules of art, in the composition of their lines, and effect of their light and shade, which will cause them to be

INTRODUCT.

from the optician,

(Improvements necessary in portrait-lenses.)

chemist,

and the artist.

Introduct. looked upon with the respect and interest the exquisite beauty of Nature's own drawing should inspire, when not marred by the unskilful translation or promiscuous selection of her votaries.

THE

DISCOVERY AND PROGRESS

OF

PHOTOGRAPHY.

History.

Without entering at much detail into the history of the discovery of the power possessed by light to fix, under certain chemical conditions, the image of objects in nature upon a plane surface, a work upon photography would be obviously incomplete were the rise and progress of the art passed over in silence.

Origin of its name.

Photography, as its name implies, is the art of *drawing by light*, which indeed is not, strictly speaking, correct, since the most illuminating portion of the sunbeam is precisely that of least photographic action.

Discovery by Daguerre.

Twenty years have not elapsed since, in artistic and scientific circles, the greatest interest was excited by rumours of the fact, that Daguerre the artist—well known to our public by his dioramic pictures—had succeeded in what had often been desired, and as often been pronounced hopeless, namely, in giving permanence to the picture pro-

History. duced in the "camera-obscura." The earliest
Its first results. results shown in London, in 1839, were marvellous representations of public monuments in Paris, views on the Seine, &c., depicted with a minutia and accuracy which astonished the beholder; they were on metal plâques, and were executed by the process since called, after its inventor, *Daguerreotype*. But though wonderful
Their nature. in the delicacy of their finish, the reflexion from the metal plate was found objectionable, nor did they possess any power of reproduction.

Fox Talbot's discoveries. Simultaneously with the discovery by Neipce and Daguerre in France, our own countryman, Mr. Fox Talbot, had perfected researches upon which he had been engaged in the same direction, and the result was, in 1839, made known under the name of the Talbotype or Calotype, which differed from Daguerre's, inasmuch as it was on paper, and the picture being negative, that is, with the lights and shadows reversed, it possessed
Calotype. the power of a plate or *cliché*, from which an unlimited number of proofs might be printed, the diaphanous texture of the paper used allowing the passage of sufficient light.

But this process had likewise its disadvantages, although they were in another direction: it was too slow in receiving the action of light, to be advantageously applied to portraiture and the
Its qualities. life, and was deficient in finesse and delicacy of

execution when landscape, architecture, and still-life were treated by it. HISTORY.

Matters stood thus when Mr. Scott Archer, in 1851, communicated to the public a new method of taking the photographic picture by means of a thin film of collodion, extended on the surface of a glass plate, and rendered sensitive to light by being treated with salts of silver. It was found in practice to combine the excellences of all previous methods, and possessed, besides, some peculiarly its own. It had more rapidity of action than even Daguerre's process; it could be manipulated at infinitely larger sizes, and had an unlimited power of reproduction, of which his was incapable; and it surpassed Mr. Talbot's by its incomparably greater sensitiveness, its superior discrimination of textures, and minuteness of detail. Collodion process discovered. Capabilities and excellence.

This is the Collodion process, which is practised far and wide, from which unfortunately the inventor, instead of reaping any benefit—as had been the case with Daguerre, to whom and his coadjutor France had granted pensions of 10,000 francs for life, with reversion to their families,—became impoverished by the expenses consequent upon his experiments in the art, and died leaving his widow and family to the sympathies of the public. The inventor not remunerated.

The Collodion process may be said to have superseded all others. Its qualities have, in

History. practice, been found available for every conceiv-

Popularity of the process. able subject, and of seven hundred works in the Photographic Exhibition of London, of this year, 1858, six hundred are due to Collodion; amongst them, showing its sensitiveness, pictures taken in the $\frac{1}{150}$th part of a second.

Other methods Such are the main phases of discovery and improvement in this wonderful art, from the first successful results, in 1839, to the present time; for, although many ingenious theorems have, during the interval, been propounded, they have either been found abortive in practice or, their

less satisfactory. qualities in various ways being inferior to the others, have been allowed to fall into desuetude. It would, therefore, serve no purpose to detain the reader by the bare enumeration of them; the intent of this volume being to describe, with considerable minuteness, the processes of the one found to give results of the greatest excellence, and by that necessary prolixity, to spare the student many disappointments, and enable

Attention to minutiæ necessary. him, by strictly following fixed details, to produce with much certainty a successful photographic picture.

PART I.

THE

PRODUCING AGENTS DESCRIBED.

ON LIGHT.

Light. Its Nature.

Before proceeding to describe the manipulatory processes, it will be proper to consider the nature and action of the chief producing agent—Light—and to observe those qualities in its composition and influence which more immediately regard the formation of the photographic image.

Sources of Light;

Light is that principle which emanates from all self-luminous bodies, such as the sun, the stars, from electrical sources, incandescent earths or metals, and the flames or sparks given out from the combustion of solid bodies or gases; and it is reflected, with more or less intensity, from every object in nature, according as the structure and surface of each may be more or less fitted by the arrangement of its components, to reflect, disturb, or absorb its action.

LIGHT.

Its qualities enumerated.

There are several distinct qualities in light, each of which enter in some shape or other into the production of the photographic picture. They are intensity, reflexion (regular and irregular), refraction, dispersion, and absorption.

Intensity due to the source,

Intensity is the quality which may either arise from the power of the source, as the sun compared with a taper, or the greater or less density, in quality or quantity, of the medium it has to traverse to arrive at a given point; thus the submarine diver receives a diminished light in proportion to the increase of his descent, and in the profound depths of the ocean darkness alone exists, since even the light of the sun is powerless to traverse the accumulated waters. On the contrary, on the summits of lofty mountains the rarified atmosphere permits us to see the stars in novel and surpassing brilliancy, compared to our usual view of them, and to discern many whose light was too feeble to reach our vision, through the lower strata of the earth's atmosphere.

or the medium traversed.

Reflexion, regular, its nature:

Reflexion is "regular" when the beam of *white* or sunlight falls upon polished surfaces of metal, or mirrors, and is transmitted from them in its integrity; that is to say, as *white* light.

irregular, its results;

It is "irregular" when it falls upon bodies and surfaces so constructed that they take up certain portions only of the coloured rays composing white light, and *reflecting* those tints alone, and

absorbing the rest, the objects themselves become to our senses *coloured,* not by any pigment they intrinsically possess, but by the varying shades of power of affinity and appropriation, which their molecules have for reflecting individual rays, which are the components of light.

gives *colour* to objects;

The foregoing may be familiarly illustrated thus—we look at a crowded thoroughfare, we see in their varied and appropriate hues, granite, cloth, velvet, bricks, tiles, &c.; every object has its "*local colour*"—this is due to irregular reflexion: a smart shower comes on, the result is that all those surfaces become wet, they then reflect regularly, so that in the camera, as to the artistic eye, pavement, tiles, cloth, &c., all lose colour, and are expressed by *white* light.

its action illustrated,

on terrestrial bodies,

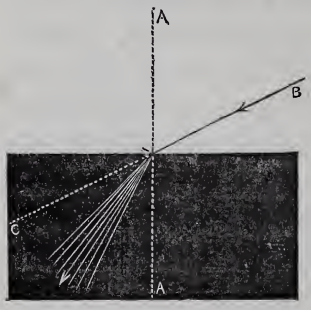
Irregular reflexion of light is the prime motor of all that is beautiful as *colour* to our senses, the aqueous globules of the mid-day silvery cloud are its varying mirrors, which anon it tinges with the colours of the spectrum in the rainbow; the rosy hues of dawn and gorgeous tints of sunset are the results of its diversified action; the endless varieties of colours, seen throughout nature, are due to its mysterious influences, reflected from myriads of facets; as has been said, *of themselves* they have *no colour;* palpable to touch some may be, hideous and livid they would by certain combinations of light appear; by the glorious sun's ray

and on the atmosphere.

Light. they glow resplendent in magic hues of varied beauty.

Refraction; Refraction is the quality which a beam of light possesses in passing from a medium of one density, as air, to another as water, glass, &c. When it strikes upon such media, at a right angle as A A, it passes straight through them, without changing its direction; when it impinges upon them in an oblique direction as B C, the ray is bent in its passage, and the angle of its deviation is governed by the nature and density of the medium into which it enters. Advantage is taken by the optician of this quality of light, he uses in his lenses glass of different degrees of density, the nature of one sort being to disperse the beam of white light; the result is, that the coloured fringes of the spectrum surround each object, one of another quality is superposed, and the various rays are reunited and white light or achromatism results.

Fig. 1.



its optical qualities.

Chromatics.

Dispersion. Dispersion is the separation of a beam of white light into its component rays, which vary from each other in colour and in refrangibility. When such a beam falls obliquely upon the surface of a

prism, it is not refracted from it in the same state, but undergoes a division which enables us to submit its various parts to analysis.

The means of separating the components of light.

If a hole be made in a shutter a beam of sunlight, in passing through it, will be received on a piece of white paper as a round white spot; but if a prism be interposed in the ray, the result will be that the image on the paper will be altered from a white circle to an elongated figure, composed of a series of tints, symmetrically arranged, and which are always, when proceeding from the same source, identical in their disposition and colour, each possessing qualities which differ widely in their nature; this is the decomposition of light, and the result is called the SOLAR SPECTRUM: its divided parts can be recombined in a variety of ways, all having for their purpose the uniting of the coloured rays. This may be effected by receiving them on a double convex lens, in its focus a *white* spot will appear—which is indeed a minute image of the sun—each coloured ray may be separately reflected from one of seven plain mirrors, so adjusted that they may be converged to one point, when white light will be the result; by rotation and several other methods.

Solar Spectrum.

How recombined.

Spectra from other sources

When the spectrum is formed from other sources of light than the sun various changes are observed in its appearance, by the omission of some of its tints, or by change in the locality of

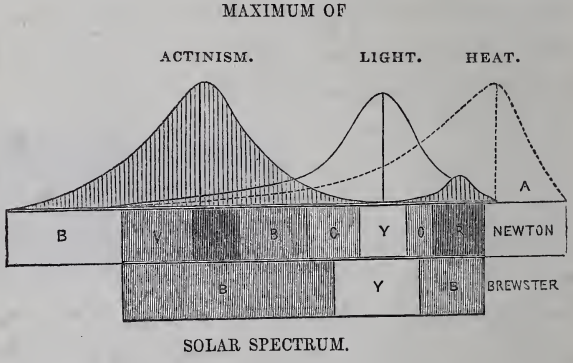
LIGHT.

others; but in the main the various spectra offer salient points of resemblance, and most of them are capable of impressing a Photographic image of greater or less intensity.

Brewster's theory.

Sir David Brewster considers that white light is composed of the *three* primary colours, blue, red,

Fig. 2.



A. Extra rays of heating power beyond the red.
B. Invisible rays of photogenic action beyond the violet.

and yellow; and that the *seven* colours described

Newton's theory.

by Sir Isaac Newton are formed by the overlapping of the edges of the rays of the three, each having its maximum intensity at the parts where the strongest and brightest tint of that colour

The spectrum,

exists in the compound spectrum; that is to say, red and yellow forming orange, blue and yellow green, &c.; be that as it may, this much is cer-

tain, that *three* distinct qualities—namely, LIGHT, HEAT, and ACTINISM—are definitely referable to distinct portions of the spectrum: illuminating power or light to the yellow, heat to the red, and, according to Dr. Herschel, to the invisible rays beyond the red; and electrical affinity and the quality termed actinism, which is the main producer of the photographic or chemical action, to the blue and to certain rays beyond that end of the spectrum, which were discovered by Professor Stokes, and which are invisible to the unaided vision.

Light.

qualities of its components;

The illuminating quality of the yellow ray is judged by the eye. The second—heat—was proved to reside in the red by experiments made with delicately constructed thermometers, by Dr. Herschel and Sir Humphrey Davy, who found that at a point an inch and a half below the extreme red the invisible rays exercised a heating power, even when the thermometer was placed at a distance of fifty-two inches from the prism.

means of demonstration.

Heat.

Sir Henry Englefield gives the following scale, resulting from his experiments:

	Temperature.		Temperature.
Blue . . .	56°.	Red . . .	72°.
Green . .	58°.	Beyond red .	79°.
Yellow . .	62°.		

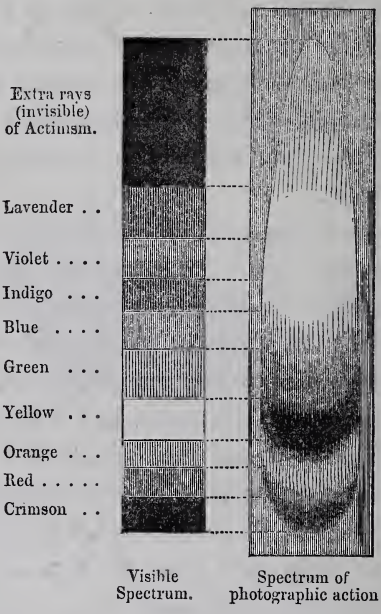
On returning the thermometer from beyond the red into the red ray, it again fell to 72°.

LIGHT.

Actinism.

The quality existing in the blue, violet, and *extra* violet portions of the spectrum, is that of the greatest importance to the Photographer; as it is chiefly by those rays that the action is impressed which forms his picture.

Fig. 3.


Extra rays (invisible) of Actinism.
Lavender . .
Violet . . . .
Indigo . . .
Blue . . . .
Green . . .
Yellow . . .
Orange . . .
Red . . . . .
Crimson . .
Visible Spectrum.
Spectrum of photographic action.

Decomposes salts of silver.

The early researches of Scheele in 1801, of M. Rittner of Jena, of Dr. Herschel, and Dr. Wollaston, all resulted in referring the power of decomposing salts of silver, now termed "actinism," to the before-named rays, and subsequent investigations have confirmed the fact.

The accompanying diagram will show the nature of the action on the position of the various parts of the spectrum in the photographic picture. It will be observed that the part opposite the lightest ray—the yellow—remains unaffected, whilst the gradations of tone up to pure white in the blue and violet give the comparative increase between the two extremes.

Action of the spectrum on them.

We thus perceive the reason that the photographic action is often deficient when apparently the light is sufficiently intense, since the foregoing analysis proves that the *visual* ray is not the one to which we are indebted for the picture; on the contrary, sensitive surfaces may be exposed for any periods in that ray unaffected, provided means are taken to protect them from the diffused light which scatters from the prism, or from the action of the other rays.

Illuminating rays not actinic.

We will do no more than notice that various experiments have been made at different times which refer a distinct and powerful magnetic action to the violet rays, many successful results have been obtained in polarizing needles and adding to the power of magnets; but on this point there is considerable controversy, and the question has yet to receive elucidation in common with much that is entirely obscure in the occult principles of light, heat, and electricity.

The violet rays magnetic.

The last quality of light, or rather condition to

Absorption.

Light. which it submits, is *absorption;* this term is used
Nature of absorption. when the illuminating principle is too feeble, the distance it has to traverse through different media is too great, or, the nature of the bodies on which it impinges not being favorable, by their structure, either to its reflection or refraction, it becomes absorbed and stifled.

When an attenuated beam of light is admitted into a darkened room, it will illumine an object close to the aperture where it enters; retire the object further and further, and its obscurity increases, until a limit may be soon reached, in a
Illustrated. large apartment, where its illuminating power ceases entirely; this is caused by the absorption of light.

Another kind of absorption is caused by the structure of surfaces, which being, like velvet, bricks, cloth, &c., porous, and offering few or no reflecting portions, the particles of light enter their numerous minute recesses and are extinguished.

It will be well that the student should note the whole of these qualities of light, since they enter intimately into the practice of Photography, either in the management of the lens and diaphragm, or
Study of light necessary. in the selection and arrangement of the picture, and governing, as they do entirely, the whole process; conformity to their nature will be the only method of arriving at successful results.

THE EYE AND THE CAMERA.

Our means in Photography of forming an imitation of the image which is presented to the mind by that most wonderful and perfect organ the eye, are the lens and the camera; and as the picture which we produce is judged entirely by its conformity with the appearances produced by the same objects in the human eye, it will be well to examine the structure of that organ, and compare the manner in which it performs its functions with the conditions imposed on us by the camera, so that we may see the points in which consist our greatest disadvantages; in order to do what is possible to assimilate their action, or at all events not to increase, by injudicious treatment of our instruments, the distance, already too great, which separates the two.

THE EYE.

Its action imitated by camera.

The necessity of assimilating the results.

The human eye is of a spherical form, and about an inch in diameter; the small circular disc in front, called the *cornea* (A), being prominent beyond the other portion. Within the cornea is a small chamber (B) filled with a transparent liquid called the *aqueous humour*, which may be considered the front lens, and on which the rays proceeding from external objects first impinge. The posterior surface of the aqueous

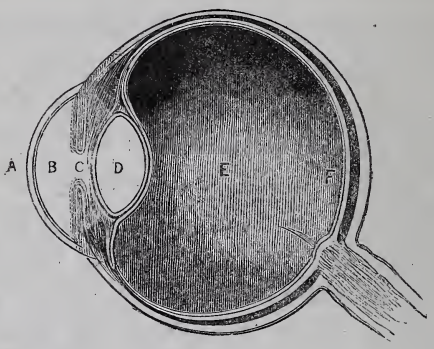
Analysis of the eye.

Cornea.

Aqueous humour.

THE EYE. humour is limited by the *iris,* which is in fact a
Iris. diaphragm, by the instant dilation or contraction

Fig. 4.



of which the aperture in its centre (c) called the
Pupil. *pupil* is, according to the intensity of the light, expanded or diminished. Its diameter varies, from little more than a sixteenth of an inch in intense light, to above one quarter in comparative obscurity. This movement, which may be observed by approaching or retiring a candle near the eye, regulates the proper quantity of light on the retina.

On looking from distant objects to those immediately near, a contraction of size of aperture takes place in the pupil, and *vice versâ,* the intenregulating the amount of light admitted. tion of which movement is to admit more light into the retina for the distant objects, and to diminish it and suppress the obliquity of the lateral rays in near ones.

Immediately behind the iris there is a capsule, in the form of a double-convex lens (D), which is called the *crystalline humour* or lens. This plays a most important part in the functions of the organ; by means of the alterations which take place in it, probably by the changes in its form and relative distance between the iris and the retina, the process of focusing objects at different distances is performed. Much discussion has taken place on this point, but the experiments of Dr. Young on persons deprived of this lens, and who were thereby incapacitated from focusing their sight, seems to put the question of the power possessed by this portion of the eye beyond doubt.

The Eye.

Crystalline humour;

power of altering the focus

A familiar exemplification of the act of focusing the sight, is given by placing one object at a yard distance from the eye, and another at six beyond it; on looking intently at either we *are conscious of the presence* of the other, but we do not discriminate its details; on fixing one we lose the definition of the other.

exemplified.

The next chamber (E) is filled with the *aqueous humour*, through which the rays pass until they, in the most true and perfect conditions of focus, impinge upon the curved surface of the *retina* (F), depicting the image upon it. This may be seen by carefully dissecting the hinder part of the eyeball of an ox recently killed, so as to lay bare

Aqueous humour.

Retina.

THE EYE. Retina shown to be the recipient of the image;

the retina; if it be now placed in an orifice in a shutter, corresponding to it in size, an observer in a dark room will see the images of objects without depicted upon it in an inverted position, remarking only that as the power of adapting the focus of the eye to the planes of distances which existed in the animal alive, may or may not be more or less defective in the unconscious organ, according as the objects presented to it may by their proximity be in harmony with the conditions it happens to possess.

its diminutive size;

The size of that portion of the retina which receives the image is, in the human eye, not so large as a sixpence, and when we consider the marvellous power of sensitiveness to infinitesimal gradations of tone, and the more than microscopical delineation of form which it possesses, together with the perfect adaptation of aperture and perfection of focus, we become sensible of the difficulties with which the effort is surrounded, to produce by optical science an imitation in the camera of the same appearances presented to the mind through the eye.

difficulties of imitating its action.

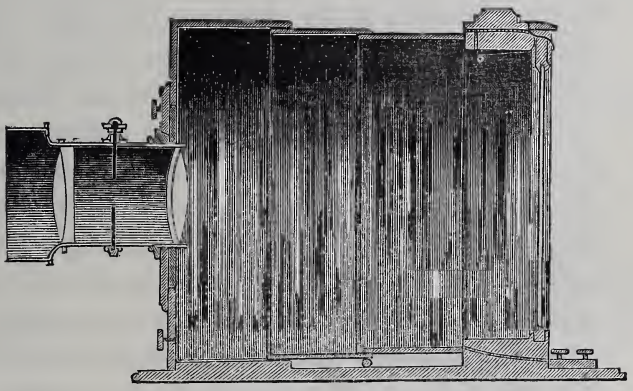
Its qualities recapitulated,

To recapitulate. We find in the eye the following qualities—an aperture of such limited area, that for all practical purposes it may be considered a *point* —power of increasing or diminishing the quantity of light admitted to the retina, and, in proportion as the objects inspected are more or less distant,

admitting the parallel, or suppressing those oblique pencils which would interfere with the absolute perfection of the image—of arranging the lenses in such a manner as shall give correct focus to objects at varying distances—the whole of the above being altered simultaneously, instantaneously, and in those nice gradations of proportion which the harmonious balance of the different qualities requires. Lastly, that the delineating rays arrive at *the curved surface of the retina* in the precise ratio of their lengths. THE EYE.

In the camera the lenses take the place of the The camera our means of imitation.

Fig. 5.



aqueous humour and crystalline lens; by a strange perversity the diaphragm, which, performing the function of the iris and pupil, should have been placed between the pairs of lenses, has been applied in front of them, and in some instances Diaphragm long incorrectly applied.

THE EYE. continues to be so, to the manifest injury of the picture.

The rays refracted from the lenses are received
Ground glass screen; on the ground glass, which is the retina of the camera.

We will now consider what are the qualities possessed by the picture given by the camera, and in what it most essentially differs from that which must be the object of our imitation—*nature, as seen by the human eye.*

difficulties of its *plane* surface. In delineating on a plane surface, by means of lenses, the appearance of objects, we labour under many disadvantages, which rapidly multiply as we increase the size of the picture. This does not apply so much to representations of distant and inanimate forms, since with them the parallelism of the rays is greater, their reflecting surfaces are
Still life. incomparably larger, they may be taken under any condition of light up to the direct sun ray, and as they are immoveable, the diminution of aperture and consequent time of exposure is of no importance; so that we may pass from the consideration of that class of subjects to those in which the difficulties to be surmounted are greater—
Living subjects. namely, in the treatment of near and living objects by the double combination lens. In proportion as we approach the person to be depicted, what is called *distortion* in the image increases; that is to
The action of the camera; say, the focal depth in the subject diminishes,

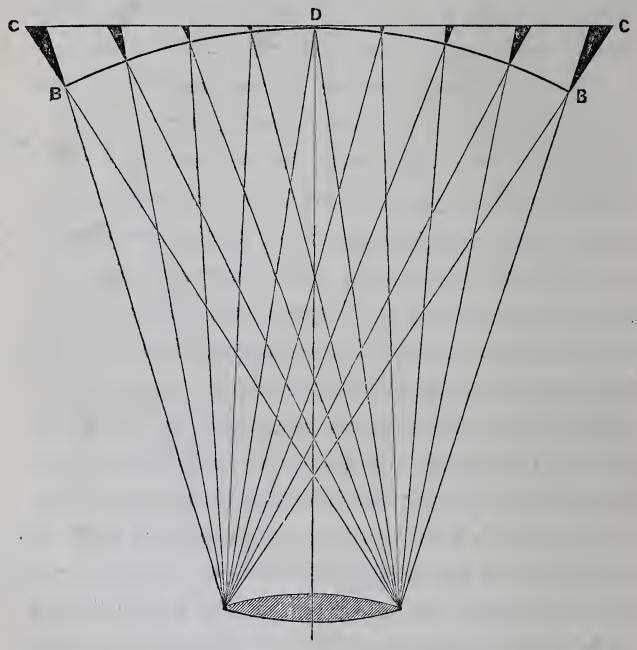
consequently all projecting portions become enlarged, and as the obliquity of the lateral rays becomes greater the nearer we advance, in order to maintain satisfactory quality in the picture, it is necessary to do precisely what is done in the human eye in such circumstances, namely, to diminish the aperture in proportion to our advance, by changing the diaphragm for one smaller in diameter. THE EYE.

But in the camera we labour under two disadvantages in all this—namely, that in proportion as we approach the subject the focal length between the lens and the ground glass is rapidly increasing, and as we diminish aperture we subtract light, both which add materially to the time necessary to impress an action on the film; besides these disadvantages, there is that imposed on us by the requirements of the art—namely, the necessity we are under of receiving the rays forming the image on a *plane* surface, the consequence of which is that those rays which, if received on a curved line corresponding to their length as in the retina of the eye, would have been as perfect in their form as the more central ones, become distorted by the manner in which their terminations are widened and obliqued by the mode of their impingement, as shown at c c fig. 6; and, moreover, as their focal length was at B, D, B, it would manifestly be damaging to the picture to retain their confusing influences: its disadvantages, compared with the eye. Action of rays on a curved and flat surface.

THE EYE. in such case we must therefore submit to one of two things, an inferior quality of picture or an increased time of exposure. In the camera great rapidity of action can only be obtained by

Lateral rays defective.

Fig. 6.



large apertures or short focal lengths; in the eye we see that the pupil is a mere point, yet even the instantaneous action of the electric spark perfectly suffices to depict objects on the retina. If in the camera large apertures are used the picture will be

Apertures in the camera; and in the eye;

most incorrect, and entirely unlike the same object as seen by the eye, a simple proof of which is the following: The Eye. effect of their diversity

Take a lens six inches in diameter, and covering all its surface except an inch on one of its sides, take a picture with that portion of it; now re-

Fig. 7.

Fig. 8.

versing the operation, take another with one inch of the opposite margin; print the two on thin paper, oil them, and superpose the prints; no two lines in them will correspond; they have been taken from two points of sight distant four inches from each other; and yet, although these two pictures are so wanting in uniformity of lines, a portrait taken with such a lens at full aperture would be much more defective, since not only two portions of its margin, but the whole of its surface, would have been looking *round* not *at* every feature and every form in the subject—in fact, it would not be a picture of a lion, but a representation of his extended hide. It thus appears that when the representations of near living objects are executed, moderate sizes must alone be attempted, which may be increased in proportion as the camera is retired from the subject, and as the and errors of larger apertures on portraiture. Moderate apertures recommended.

THE EYE. reflexive area of it is augmented. The use of medium sizes of lenses, which will in their action permit a balance of disadvantageous qualities, is desirable, until the time arrives, if ever it should, when the apparently irreconcilable conditions are united in the lens, which will enable the operator, with a *small aperture,* to cover a fair *extent of surface,* and to produce an image *perfect in drawing with rapidity.* In the meantime the photographer, who aims at a successful result in this class of subjects, will do well to bestow all his attention in endeavouring to assimilate, as much as possible, the action of the camera to that of the eye, as it is by the unerring and practised comparison of the latter his pictures will be judged.

Optical difficulties.

Necessity of appreciating the two conditions.

LENSES.

LENSES. Although the *construction* of lenses is the more immediate concern of the optician, the skilful *application* of them to their different uses is entirely the province of the photographer; and his pictures will be dependent, for many of their qualities, upon his perfect knowledge or otherwise of the extent of the capabilities and nature of action of his lens.

application by the photographer:

The lens is the object of primary importance in his apparatus; it is at once an *atmosphere,* with

their importance in the process;

novel conditions, through which he invisages nature; and the rays refracted from it are the *pencils* with which he delineates his picture. If it be defective in its qualities, no matter what dexterity, neatness of manipulation, or artistic knowledge he possess, it will be utterly impossible for him to produce a *perfect* photograph. Yet even the lenses made by the most skilful opticians leave much to be desired: the smaller diameters, it is true, are sufficiently deep in focus, rapid in action, and vigorous in intensity on the glass, and definition in the picture; but the negatives they are capable of producing are very limited in size, and in proportion as the operator increases the dimensions of his picture, and is consequently obliged to use larger and larger lenses, his difficulties, in this direction alone, multiply in an enormously increased ratio, until the time necessary to produce a picture is so prolonged as to put a veto upon subjects *from the life* being undertaken at all.

the result if defective;

their capabilities;

defects,

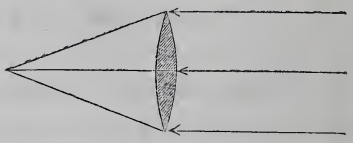
The qualities of a lens are governed by two leading principles,—the nature of the refraction possessed by the media composing it, and the forms which are given to their surfaces. Lenses are generally made of glass, but can be composed of any transparent non-crystallized medium, provided that one or both the bounding surfaces are more or less curved.

and nature;

Lenses. Lenses may be divided into two classes,—the *converging* and *diverging*, according as the nature of the action of their curves upon parallel rays of light is to gather them to a point, termed the *focus*, as the double convex,

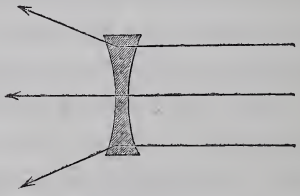
their action on parallel rays;

Fig. 9.



or to scatter them, as the double concave.

Fig. 10.



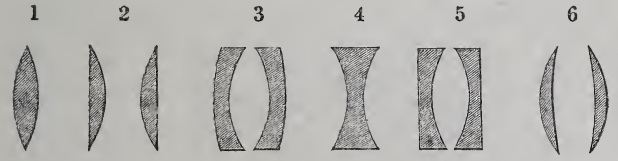
in the The action of a lens may be seen *drawn in the air* by itself, in the following manner: Paste on the lens a dark paper, pierced with holes, symmetrically arranged; make an orifice in a shutter facing the sun, place the lens in it; the nature of its action on parallel rays will at once become visible.

Science of optics. Advantage is taken by the optician in the scientific adaptation of varying degrees of curved surfaces, to antagonise the distortion in the form of the image, which, were such combinations not

made, would appear; the result of these being, when skilfully effected, to reduce the "*spherical aberration*" to a minimum. Lenses.

There are several forms of lenses, each of which gives a different quality of direction to the incident ray. They are— Dioptrics.

Fig. 11.



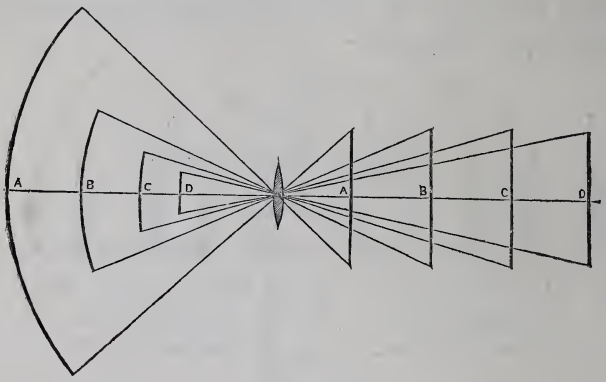
1. Double convex.
2. Plano-convex.
3. Concavo-convex.
4. Double concave.
5. Plano-concave.
6. Meniscus.

It has been shown, in the section on the Eye, that one of the greatest disadvantages we labour under in our imitation of its action, is the necessity imposed on us of receiving the image on a *plane* surface, whereas the retina is curved. The efforts of the first mathematicians have been directed to the study of the best arrangement of surfaces which the lenses should possess to neutralize this damaging condition; and their calculations, and the skill of the leading opticians of Europe, have, to a certain extent, been successful. Still, however well a lens may have been "corrected for spherical aberration," it is always a quality which, in proportion as we use the Eye and lens, difference in action. Spherical aberratio

Lenses. whole of the diameter of the lens or advance nearer the sitter or the object delineated, makes

how increased; itself more and more felt, and requires all the tact

Fig. 12.*



and skill of the operator to remedy as much as

how diminished. possible; the means of doing so being by judicious adaptation of diameter of aperture to the conditions above named, and will be treated of under the head of Diaphragms.

When light strikes in an oblique direction on a transparent medium, the beam is diverged from

Refraction of light. the direction it was pursuing more or less according to the refractive power it encounters in its

* The dimensions of this work would not allow the diagram to be drawn on a larger scale. In order, therefore, better to mark the differences caused in the *lines* of the *pictures*, the relative size of the *object* taken was diminished,—it suffices to show its change of position.

passage, which differs considerably in all such media as the diamond, glass, water, oil, spirits, air, vapours, &c. The nature of the refraction of rays of oblique incidence may be seen on looking at an oar in water, or by allowing a minute sun-ray to pass through a hole and receiving it in a vessel of water, the change of direction on its entering the fluid from air will be distinctly perceptible. In addition to this change in its course, its incidence in the above conditions has dispersed or divided the beam into its coloured components; the effect of this in lenses would be, if uncorrected, that each object would be seen surrounded by coloured fringes, but as the refracting powers of flint glass and crown glass differ considerably, the dispersed rays refracted from the one are re-united in their passage through the other, "*achromatism*" results, and the coloured fringes disappear.

Nature of media.

Dispersion of light.

Achromatism.

This is the case in telescopes, microscopes, &c.; but as their application is intended for *vision* alone, it is only necessary that their lenses should be "corrected for colour" to such a point as to recombine the rays which form the image to the *eye*. But the photographic lens differs from these in this important particular, that it is not addressed to our sight, but to *chemical action* on the film, part of which resides in a portion of the spectrum invisible to the unassisted vision. Not

Telescopes and microscopes.

The photographic lens;

Lenses. to include them has no effect on the perfection of the image in a telescope; to neglect including them *all* in the photographic lens corrected for coincidence of foci, is to retard and confuse its action in the proportion in which more or less of them may have been omitted.

corrected for coincident foci;

If the lens is so constructed that the two foci are not intended to coincide, the nature of its action is as follows: the eye appreciates the picture as seen on the ground glass by the visual rays—the yellow; but if the collodion film were placed in that focus, those rays being a blank in photogenic quality, the picture would be delineated by the *actinic* rays, for which—being refracted further from the lens—the film would not be in true focus; and the result would be confused and blurred.

not corrected for coincidence.

Image drawn by the actinic rays.

Therefore, with this class of lens, it is necessary to *inspect* the picture on the ground glass, and afterwards to "turn out" the lens in order to place the film in the point of maximum actinism.

Difference between the two methods.

The difference between the two methods of construction is this; in the first the *whole* of the coloured rays are converged to one point, and the image is formed on the film by their united action as white light; in the other, the red and yellow rays are entirely ignored, and the film is placed in a point of the actinic portion only.

Treatment of lens when not coincident.

In practice it is found that a lens not coin-

cident in its foci requires "turning out" more in proportion as it is approached to the sitter, or as the entire aperture is used; and, that, as it is withdrawn, or its aperture diminished, the difference between the visual and chemical foci is less till at a certain point in either direction—of distance or aperture—the two foci coincide. LENSES.

The reason of this is that the obliquity of the lateral rays diminishes, and they become more parallel and less dispersed as we retire, or by excising them by diaphragms they are excluded, and the picture being relieved from their confusing influence, is depicted by the action of the central rays alone, which pass through the lens in a more homogeneous state of colour and unity of focus. The same action is sensibly felt in lenses coincident in both foci, although to an infinitely less extent. Action of lateral rays; and of parallel.

This is only according to the primary law of light, which passes unchanged through a refracting medium, which it enters at a right angle, but which is more or less dispersed in proportion to the obliquity of its incidence. And, indeed, the principle extends beyond the mere instrument; the very atmosphere surrounding us is every instant—from sunrise to sunset—acted upon in the same manner. This it is that gives the greatest photogenic quality to the vertical *white* beam of the midday sun, which, as he descends towards the Action on our atmosphere.

LENSES. horizon, diminishes in proportion as his rays, refracting obliquely through our atmosphere, disperse and colour more and more as he recedes from the zenith, until in the vivid *reds* and *yellows* of his setting glory he disappears.

Its effects on the process.

So when some sudden change takes place in the actinic power—as is constantly proved by the camera without our being visually conscious of it—the nature of the light, as emitted from its source, the sun, remains the same, but within our atmosphere, or by the passing clouds or vapours near the earth, its beams are obliquely reflected or refracted, and for the moment dispersed in rays more or less coloured and unfitted for our purpose; the cause removed, actinism returns.

Lenses constructed on both systems.

Lenses on both systems—the coincidence and non-coincidence of the two foci—are constructed by different opticians of great celebrity, and opinions are divided as to which method offers—apart from convenience in focusing—the greatest advantages; the system which combines the *whole* of the spectrum, including the rays of greatest actinism with the retardive portion—or that which ignores entirely the red and yellow rays, and placing the film beyond their influence executes the picture, by the action of a part only of the spectrum. The author's experience in practising with both inclines him to prefer the "*coincident*" lenses, as giving more equable results.

Opinion on their qualities.

LENSES.

The photographic lens varies in its construction and dimensions according to class of subject and size of picture intended to be taken with it.

Vary with subjects treated.

Lenses are either "*single*" or "*double combinations.*" The first are intended for pictures of inanimate objects, in the treatment of which the time of exposure is of no importance. Their focal length is greater than the double, consequently, at the same diameters, larger pictures are obtained. "*Double combinations*" differ from them in having a second pair of lenses behind the first pair, which, intercepting the rays refracted from them, causes them to focus at about a quarter less than their former distance, whereby the action is accelerated, whilst at the same time the curves of the back pair are so combined as to diminish the obliquity of the rays passing from the front; thus the pencils are relieved from the confusion consequent upon dispersion and spherical aberration—both, as has been shown, attributable to defective parallelism—and thus purified in their action the image they impress is more delicate in its definition and rotund in the appearance of the forms delineated; whilst under these conditions of double correction the aperture which can be used is of much larger diameter than would have been possible with the front pair only, and thus the action which, to impress the same image, would have necessitated an exposure of sixty seconds, is accelerated, and ten suffice.

The single;

the double combinations,

accelerate the action,

Refine the image.

Comparative rapidity.

LENSES.

The double or "portrait" lens is made of several diameters, the smallest one $1\frac{1}{2}$ inch, with a focus of $2\frac{1}{2}$. The sizes then augment to 2, 3, 4, 5, 6, 8; and Mr. Andrew Ross, the optician, has constructed a combination of 12 inches. Besides the variation in diameter, double lenses are made with the surfaces of their components more or less curved, which causes the focus to be diminished or increased in its distance from the lens. This regulates the size of the picture which is given; thus, 3-inch double combinations are made with focal lengths varying from $2\frac{1}{2}$ to 12 inches, the first giving an *instantaneous* picture in the fraction of a second, but of the limited size of $3\frac{1}{2}$ by $2\frac{1}{2}$ inches; the second capable, by a suppression of its lateral pencils, of covering a surface of 10 by 8 inches in twenty seconds.

Various dimensions.

Size of resulting picture.

The writer has an 8-inch Ross which covers a diameter of 30 inches in sixty seconds, $2\frac{1}{2}$ front lens.

Some data of various sized lenses.

A 6-inch Jamin covers a diameter of 20 inches in forty-five seconds, $2\frac{3}{8}$ aperture.

A 5-inch Voigtländer covers a diameter of 16 inches in thirty seconds, with 2-inch aperture.

A $4\frac{1}{2}$ Ross covers a diameter of 13 well to the edge—*published plate of Don Quixote.* With 2-inch aperture takes a three-quarter portrait on 12 by 10 in twenty seconds.

All the above in the most favorable atmospheric conditions.

3-inch diameters, by various makers become more deep in focus in the picture, and are rapid, but cover less surface. LENSES.

The smaller sizes present infinitely less difficulties in every way, but give only diminutive results.

The peculiar differences arising between various sizes and combinations, apart from their perfect construction, are *dimension* of resulting picture, *time* required to execute it, *depth of focus* in the subject, and *quality of definition* in the finished work; all of which vary considerably according to the nature of the combination. Qualities arising from various sizes.

The *dimension* of the picture arises from the diameter of the lens, and with the same diameter, is greater as the focal length increases, and less as it diminishes. Dimension of the picture.

The *time* of execution depends upon the area of aperture, compared with the greater or less focal distance from the lens to the film. Rapidity.

Depth of focus in the subject is a most important quality, which diminishes in the ratio that the length of focus in the camera is increased. Depth of focus.

Quality of definition arises from several causes. Unskilful chromatic correction by the optician will cause the rays to overlap one another and confuse the image; excess of spherical aberration will give a lens in which the centre and margins cannot be in simultaneous focus; size of picture Definition. Fault with the optician;

LENSES. attempted compared with the reflexive area of the subject gives a *weak* image.

with the operator. Want of skill in the operator, in approaching nearer his model, and not cutting off the lateral rays, gives distortion and confused definition.

The small-sized lenses give images of greater intensity, rotundity, and freedom from distortion than the larger, which demand all the skill possessed by the photographer to prevent them becoming defective in those qualities.

The various sizes of lenses necessary to execute certain classes of subjects will be given in treating of each of them.

How to test a lens. The test about to be described will enable the photographer to decide, at one and the same time, the qualities possessed by a lens in *all* the above points.

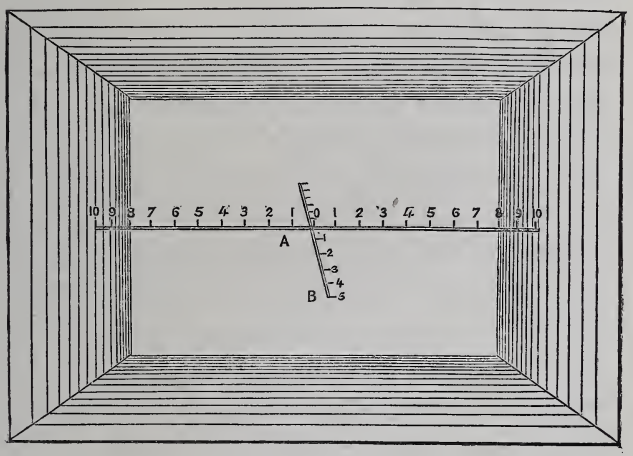
At one end of the glass room construct, either with light wooden laths, or strings drawn across between nails at *regular intervals* of some six, nine, or twelve inches, a figure of the nature of the one given below; it may be either upright, square, or oblong.

It will be well to suspend a large printed paper or poster between the points, 2, 2, on the central parallel line, and immediately in front of it a life-size bust; much of the rest of the space may be filled in with a variety of objects of still life, taking care, however, not to hide the

numerals. Now place the camera precisely opposite to, and at a *right angle* with the centre of the subject, level it with a spirit level and fix it securely, use the *full aperture* of the lens, and

Position of camera.

Fig. 13.



focus very exactly on the centre at 0; take the picture, say in eight seconds with a $4\frac{1}{2}$, in five seconds with a $3\frac{1}{2}$ lens, according to light, develope it. If it is wished to compare a second or a third lens of the same size, unscrew the first and replace it with a second—should it not fit the same flange, it will be necessary to have a temporary front slide made in common deal,—refocus on *precisely* the

Comparing several lenses,

Lenses. same point in the subject; be as rapid as possible in manipulating, in order that the conditions of light may not vary between the two pictures, take it exactly in the same time of exposure.

at full apertures, with diaphragms. Having taken the results with full apertures, it will now be well to place, say 2-inch, diaphragms in all the lenses, whether 3, 4, 5, or 6-inch diameters, and take pictures, giving, say, 15 to 60 seconds, according to the size of the lenses, and the state of light. Observe that all the conditions and manipulations must be as strictly as possible *identical*.

The printed results. Now, on printing the results, it will probably be seen that, even if the lenses were of the same maker, and of the same focal length and diameter, they may vary considerably in their qualities.

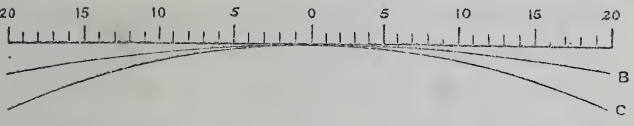
Of rapidity. That No. 1 in a 40 seconds' exposure gives a perfect image, while No. 2 would have required 5 seconds longer; *ergo*, No. 1 is in 40 seconds, 5 seconds the

Definition. more rapid. For clearness of definition look to the full aperture pictures, see especially how the printed sheet compares in each and the rest of the objects seriatim. Flatness of field is what the numerals on the long central line will more particularly decide; take the full aperture pictures and examine that line, see how far along it, from the central point *perfect*, or nearly perfect, definition of the numbers is maintained, and the figure at which in each it becomes defective, and

you may find the difference of flatness of field as much as shown in the diagram,

Flatness of field.

Fig. 14.



and that consequently B is the lens which is flatter in the field than C, which would not only give it more correct drawing, but enable it to cover a larger surface. The *depth of focus* in the picture will at once be shown by the numerals on the staff at right angles with the lens; according as more or less of them are in focus from the central point 0 to 5, *front and back*, so is the action of the lens, in this particular, more or less perfect.

Depth of focus.

In general, in testing a lens, far too much stress is laid on its power of "copying a sheet of the 'Times'!" and the much more important quality—to its purposes—of *depth of focus in the picture* is overlooked; the consequence is, that when a *portrait* is taken with such lenses, a shallow line of correct focus, through the figure and drapery, is in immediate contact with the most misty and distorted forms. Such lenses are excellent for copying oil paintings, &c.; they have a *large, flat* field, and, for such uses, the shallowness of their focal depth is of no consequence.

Not sufficiently appreciated. The consequences.

LENSES.

Qualities necessary to a double lens.

The main object of a "portrait-lens" is what its name implies, and the qualities most requisite it should possess for that purpose are—rapidity, depth of focus, and good definition; the first and last go together, being both governed by the same cause, namely, the *perfect* concentration of *the whole* of the rays, *including the "lavender."*

Chromatic correction defective.

When by unskilful chromatic correction any of these have been omitted, their disturbing influence—out of true focus—is felt in *definition*, and the lens, deprived of their actinic power, is

Gives faulty definition, and slowness.

slow in its performance. This mode of testing their qualities applies equally to single lenses, but they have at the same diameters deeper focus, a flatter field, and give a larger but a weaker picture. Their appropriate sizes and apertures will be treated with the subjects for which they are used—as landscapes, copying, stereoscopy, &c.

DIAPHRAGMS.

DIAPHRAGMS.

Description of.

Diaphragms, or stops, are metal plates perforated with a central aperture, ranging from one eighth of an inch up to nearly the full diameter of double combination lenses.

Their action explained.

They increase the clear definition in the picture by their action on the marginal rays reducing the spherical and chromatic aberration, and they add

to the focal depth in the subject; but for every diminution of the diameter of aperture a corresponding reduction in the quantity of light which illuminates the collodion film takes place, and there is, therefore, with the double lenses especially, a limit of decrease of aperture which should not be exceeded, as otherwise the deposit of silver on the glass will be too weak and inefficient to print well; and as the time necessary to take the picture increases most rapidly *pro rata* as the size of aperture diminishes, the artist must be content, when operating from the life, to sacrifice some portion of *definition* in his picture, the better to secure a vivacity of expression in the countenance. Practice only will enable him to decide *on the instant* what aperture certain qualities of light, subject, and lens will require, and beyond which point it would be objectionable to reduce it; and the acquisition of this faculty is so necessary to the proper use of the lens, that I would advise the student to address himself diligently to the observation of the variations caused in the action of his lens by different applications of diaphragm; to note the time of exposure, the conditions of light, temperature, bath, and collodion, under which the picture was executed, which experience alone will make him master of the variety of effects consequent upon the manner of working the lens with *different apertures*,

Judicious application of.

Note carefully the results.

Diaphragms. according to light, subject undertaken, and qualities desired to be obtained in he picture,—the importance of which study to a perfectly successful result cannot be better illustrated than by the fact that by skilful adaptation of his diaphragm one operator shall, with an inferior lens, make a fair picture, whilst the inexperienced will utterly fail with the most perfect instrument that the optician can furnish.

Greatly improve even a bad lens.

Long erroneously placed.

Many works on photographic manipulations direct the diaphragm to be placed in *front* of the double combination lens, and, indeed, arranged in that manner they have been always delivered by the first opticians. Operators are still found who neglect the benefit to be obtained by placing it in its proper position, which is *between* the two lenses. The advantages of which are, that the spherical aberration is thereby reduced to a minimum, that there is more depth of focus in the picture, that more light, at the same aperture, arrives to the film, consequently that there is more rapid action, and that from the same lens, at the same area of aperture, a much larger picture is obtained. More than a year ago the writer had extra apparatus made to his lenses for carrying the diaphragms between the combinations, it being then quite unusual to use them in that manner. The great advantages which he found in the quality in working with them had one serious

Their true position.

Its advantages.

drawback, namely, that it was necessary to unscrew and take the lens to pieces several times in taking a portrait; and this tedious and unnecessary manipulation had to be carefully gone through just when the whole of the operator's attention was required to be devoted to his subject. The photographer should arrange his sitter and inspect his subject at the *full aperture* of his lens; he not only has more light upon the subject in the camera, but the planes of perfect and of faulty focus are at once so defined, that he is facilitated in improving the arrangement of his picture by advancing or retiring any portions of it. Having done this he must now, acccording to the exigencies of focus in the picture, and the quality that the light at the moment may happen to possess, arrange his area of aperture, on which in fact depends the definition and time of exposure of his picture. How is he to do this if a valuable instrument has to be taken in pieces *each time* to place the diaphagm required? when at the same moment his light may be altering, and by the delay most certainly the expression of his sitter's countenance will be deteriorating. The accompanying wood-cut will show a *diaphragm-holder* invented by the writer, whereby any desired change, either for enlargement or diminution of aperture, may be added on the instant, or *changed*, according to the option of the operator, and with the greatest

DIAPHRAGMS.

Inconvenient manipulation.

Necessary to fix or change instantaneously,

for the light and sitter.

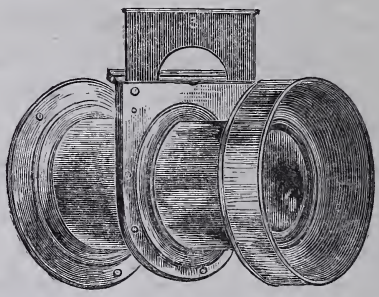
New method of placing.

Its facility.

DIAPHRAGMS. New diaphragm holder.

facility. Fig. 15 represents the diaphragm partly drawn up in the holder, in order to give a better idea of the mode of arrangement, which is so contrived as to give the greatest rigidity to the

Fig. 15.



tube of the lens, although it is necessarily cut through for half its diameter; at the same time; it allows the diaphragm to be placed or changed with the most perfect facility, and light to be totally excluded by the hinged cap being shut down; the placing or changing occupies two seconds.

Necessity of focusing the lens *subsequently.*

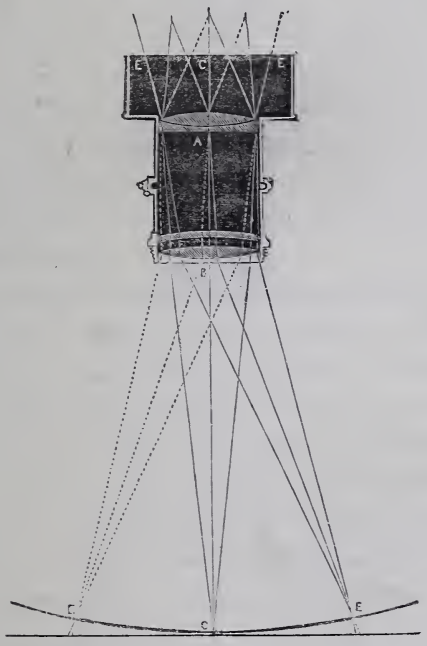
Note, that the lens must be focused—with the focusing tube—*after* the diaphragm is *in situ* and not *before,* as the length of the rays refracted by the lens varies with every alteration of aperture, being longer as it is smaller, and *vice versa.*

We will now examine the variations which are caused by the position which the diaphragm occupies relatively to the lenses, in order that the

reader may clearly appreciate the differences between them. DIAPHRAGMS.

Fig. 16 represents a section of a $4\frac{1}{2}$-inch double or portrait lens at its full aperture, with the manner in which the pencils of light from the subject pass through the combinations, and are Photographic lens at *full aperture.*

Fig. 16.



refracted by them to the film. A is the front, B the back lens, C C the central rays, E E the lateral ones; the line of focus at the film, D will be observed to be curved, and always is slightly so, even in the best-corrected double lenses, when the full Nature of its action.

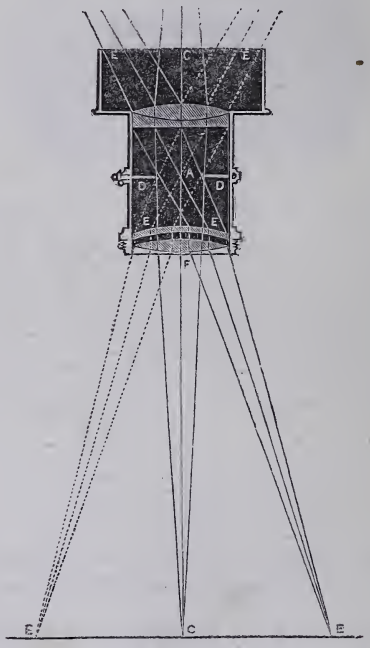
DIAPHRAGMS. aperture of the lens is employed; the consequence is that the picture is circumscribed in size, and

Its conditions

that in proportion as it recedes from (c) the central rays, imperfect definition becomes more and more apparent on the *plane* surface of the film.

The attention of the reader must be directed to the *width* of the pencils refracted from the lens at

Fig. 17.



this aperture, and the obliquity of the direction of

altered by diaphragm.

the lateral ones (E E), in order that he may observe the changes which the application of a diaphragm will at once effect in them. Fig. 17 is the same lens

with the pencils of light drawn to scale; a diaphragm (D D) of two inches aperture (A) is now added between the combinations, the effect of which has been to diminish the obliquity and give more parallelism to the rays proceeding to the film, and more depth in the focus. On contrasting the width of the pencils E E with those in the last diagram, they will be found to be diminished in their diameter by one half, with more delicacy of delineation, but at the loss of rapidity of execution by the abstraction of a corresponding illuminating area. The length of the focal distance from the back lens to the film is increased, but with a well-corrected lens the field, under such conditions of aperture, is flat.

DIAPHRAGMS.

Diaphragm *between* the combinations.

The changes it causes.

We now pass to the second manner of placing the diaphragm—namely, in *front* of the lens. This mode is only good when copying pictures, prints, maps, and perfectly flat surfaces is undertaken. It will be observed, in the first place, that the distance from the aperture (A) to the film is increased by this treatment, consequently that a longer exposure is required; but the most important change is, that the diaphragm (D D) has entirely masked a considerable portion of the *front lens;* in placing it *between* it will be seen, on reference to fig. 17, that was not the case, but that rays from the whole surface of the front lens were converged to the diaphragm; this, of course, has a material

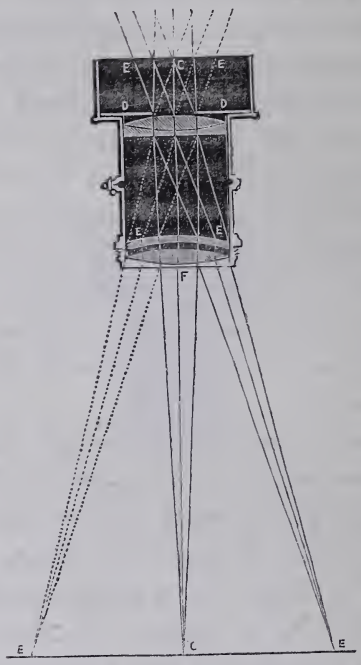
Diaphragm in *front.*

Its defective action.

Comparison of the two methods.

Diaphragms. effect on the *time* in which the same lens, in these two different conditions, will take the picture; for

Fig. 18.



the distance from the diaphragm in front (fig. 18) to the back lens being six and a half inches, and the focal length thence to the film being fifteen, it follows that the illuminating aperture was reduced to its minimum, at twenty-one and a half inches from the collodion film, whereas the distance from A to E, in fig. 17, being three inches, eighteen

Picture increased in area.

inches is the distance at which light is first restricted by diaphagm, so that a clear gain of three and a half inches, or more than one seventh of focal length, is established. The illuminated disc, given by the lens on the glass, is likewise increased in size by placing the diaphragm between the combinations; in the lens in question one inch and a half was added to the diameter of the picture. Diaphragms.

Enough has been placed before the reader to show him that AREA OF APERTURE is the very helm which regulates and guides the photographic action; if too much diminished not only the time of exposure becomes irksome, and the expression of the sitter's countenance suffers, but a harsh and unnatural edginess characterises the picture. If, on the other hand, it was allowed to be too great, the oblique pencils, which it should have corrected, interfere with the perfection of the image, and distorted forms and misty outlines are seen. Importance of area of aperture. Decides the qualities of the picture Result of neglecting it.

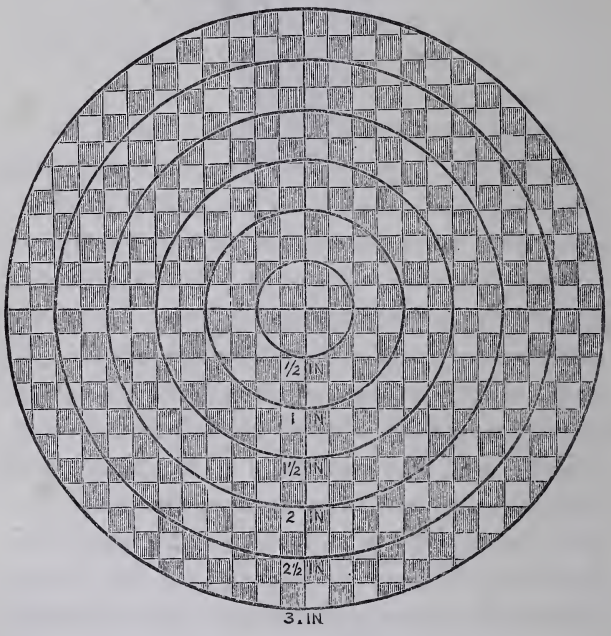
So that as *time of exposure* and *quality of definition* are entirely dependent upon the proper use of the DIAPHRAGM, the necessity of carefully studying its varying action will be apparent; and so altering the size of aperture, as may be most appropriate to the circumstances of *light*, size of *reflecting area* of subject and *distance* of the lens from it, that not one pencil of light shall be suppressed which could contribute to forming the

DIAPHRAGMS. image correctly, nor any allowed to remain which, by their obliquity, would distort or confuse the picture.

Scale of different diameters.

The accompanying scale will assist the student

Fig. 19.



in comparing, with sufficient precision, the difference of area from one sized diaphragm to another, and basing his calculations for time of exposure accordingly.

PART II.

THE REQUISITE APPARATUS.

THE GLASS STUDIO.

Glass Studio.

In taking portraits of any size, or arranging groups from the life, no good results can be obtained in Photography, unless they are executed in a glass room or studio, specially designed with regard to the requirements of the process, as the least wind deranges the hair of the sitters, and the ribbons, folds of draperies, &c., of their costume.

Necessary in portraiture;

In other respects, the necessity is detrimental to the photographic action, since all glass gives a greenish tinge to objects placed under it. We have only to compare the faces of persons standing under the first railway station with those outside, to feel convinced that such is the case.

but diminishes light.

We will now consider what are the desirable

Glass Studio.

conditions of aspect, form, and size, which have to be studied, as being the most favorable for the purpose.

Its proper aspect.

A locality open from N.E. through N. to N.W. is the best, taking care that the light is not masked by high buildings towards those quarters, but that, if possible, it is uninterrupted from the zenith to the horizon, which will give the operator the power of using it at such an angle as may best suit the subject he may be treating; and modifying, by blinds, the greater or less degree of intensity of light on the features of his sitter, according to circumstances.

Improper aspect,

No arrangement of blinds can, by any possibility, give an equally favorable result, should the glass studio, instead of facing the more even moderate light of the aspect above described, be erected facing the south; the disadvantages being, that the light is too powerful and most uncertain, and, owing to the passage of clouds before the sun, and from the changes which take place in the light on the sitter, from one second to another, it becomes impossible to calculate with the requisite accuracy the time of exposure; moreover, the potency of the light approaches, in some degree, the effect of the direct sun-ray, and the picture is likely to be harsh and discordant; black shadows and rocky white lights taking the place of the more delicate gradations

from its variable nature.

in both, which should have been seen,—indeed, in every way a south aspect is to be avoided.

Size of the studio.

The size of the building will of course greatly depend upon the class of pictures which the photographer proposes to take in it. Groups of numerous figures, full-length portraits, with accessories, executed with large lenses, will naturally require more space than works of less dimensions, such as single figures and small portraiture—for the first, fifty feet by twenty-five, forty feet by twenty, or thirty feet by twenty, will not be too large; for the second, twenty feet by twelve, or fifteen feet by ten, will suffice.

Regulated by nature of subjects.

Best form for its roof,

The slope of the glass roof should be so arranged that at the part where the sitter is placed the light may be incident upon the subject with the least disturbance of its components; an angle of forty-five degrees, if the angular form of roof is used, will be the best; but if the extra expense is not an object, much better results will be obtained from the adoption of the half-cylindrical form—as the writer's experience of the qualities possessed by two glass studios, in identical aspect and in juxtaposition, but of the two forms in question, leads him to give greatly the preference to the circular, as possessing more evenness and greater rapidity under equal conditions of light. It may be accounted for in this manner—owing to the continual variation in the position of the sun, it is

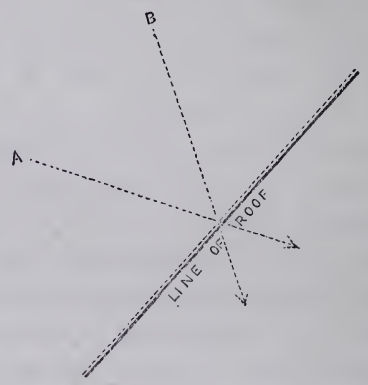
circular;

Glass Studio.

not possible to adjust the angle of the straight-sided glass roof in such a manner that the light may pass at right angles, and with the least disturbance or loss of a portion of its power; by the obliquity of its impingement on the glass; it will, except at one particular interval, be incident at an oblique angle to the glazed surface, either as at A or B, and thus suffer a derangement

disturbs the incident light less;

Fig. 20.



or loss of some portion of its actinism, which is probably the reason that in practice the quality of light is found better which has passed through a *circular* form of glazed surface, which always presents the same conditions to the incidence of the luminous principle, whatever may be the angle at which it impinges upon it, as at A, B, C, fig. 21.

presents the same conditions to every angle.

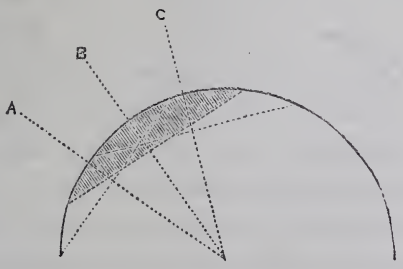
The *colour* of the glass used for this purpose is

of the utmost importance, the retarding influence of *greenish* tones in the ordinary glass being very great. An extra outlay for perfectly colourless

Glass Studio.

Colourless glass recommended.

Fig. 21.



sheet glass, which is now manufactured, will amply repay itself by the increased rapidity with which pictures can be produced—the advantages to be gained, where portraiture is intended, cannot be over-estimated.

The means of diminishing light, when in excess, by white blinds, should be arranged; they should be fixed half from above and half from below, from the eaves and the ridge of the roof, thus giving the power to the operator of not only regulating exactly the quantity but the *angle* of light used to the subject, from about twenty to sixty degrees, as may seem best to him. The floor should be constructed with the greatest care and solidity, many failures arising from the tremor imparted to the camera by movements across a weak floor, and which are increased in their detrimental effect in

Arrangement of blinds.

Solidity of floor.

Glass Studio.

proportion as the camera is raised in height from it.

Colour of walls,

The walls should be distempered or hung with paper, in which greys, blues, violet, *bluey* greens, or white are the only colours—or one or other of them at option—avoiding strictly patterns in which yellows, yellowy greens, reds, or browns appear; which must also be considered in the carpeting or drugget; an uncovered deal floor gives, when new, very pernicious reflexions.

and carpets, &c.

Its temperature.

Such a room will be found extremely variable in its temperature, in excess of heat in summer and of cold in winter; ventilation at a *high level*, and arrangements for warming, by hot-water pipes or stoves, must be provided; and from this quality it is obvious that the cameras should be removed after use, in order that they may not be rendered inefficient by the warping and derangement of their parts, and that no chemicals of any description should be kept in any part of it.

Removing cameras and chemicals from it.

Polished surfaces detrimental.

It will be necessary that no considerable varnished or French polished surfaces are in it, since the reflexion which they would give might occur in a manner to derange the light and shade on a sitter, and the vicinity of any bright or glittering objects would be seriously detrimental in copying oil paintings.

It is of great importance that the glass studio should be in as immediate contiguity as possible to

the operating room, as thereby delays are avoided, which in warm weather may have damaging results, in causing the collodion film to lose sensitiveness.

GLASS STUDIO.

Its contiguity to the operating room.

THE OPERATING ROOM.

OPERATING ROOM.

A little contrivance and knowledge of the requirements which have to be provided for, will make the difference between an inefficient black hole, and a room in which the operator can work with celerity and certainty.

Should be conveniently arranged.

Small and inconvenient dens may be made to do duty on occasion; but if it be possible to obtain a certain space, say sixteen feet by twelve, for the purpose, it will be well bestowed, both in the increased convenience for the production of the negatives, and for the health of the operator, by the superior ventilation it affords.

Its aspect.

The aspect should if possible be N.E., to avoid the direct rays of the sun upon its yellow blindages; the window should be glazed with yellow glass, by the light transmitted through which paper may be excited and bath solution prepared; but in operating for the camera, a curtain of two or three thicknesses of yellow calico in addition will be found necessary, according to the greater or less sensitiveness of the preparations.

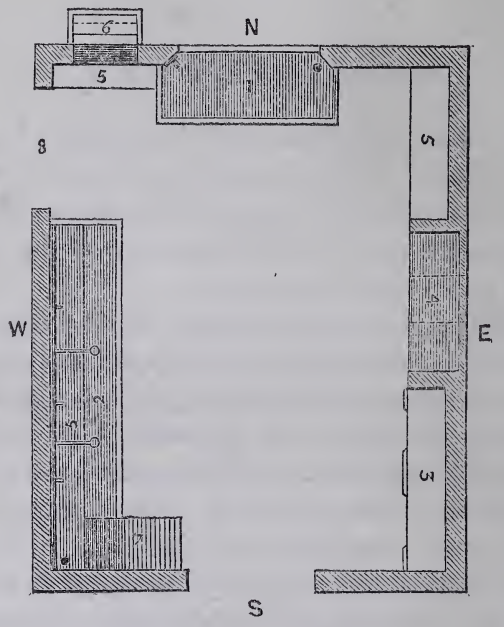
Yellow light alone admitted.

Operating Room.

Means of heating

The room should have a fire-place for warmth in winter, and ventilation, or drying of excited papers; and if there is a small boiler for hot water

Fig. 22.



1. Developing sink.
2. Sink for washing negatives, with gas, and water laid on.
3. Cupboard for chemicals.
4. Arnott's ventilator.
5 5 5. Shelfing.
6. Air-shaft.
7. Rack for trays.
8. Door into glass studio.

to the stove, it will be found advantageous in a variety of manipulations.

and ventilation.

A large Arnott's ventilator at the top of the

room in the flue, and an air-shaft, *not admitting light*, with small flap doors to close when desired, at the level of the floor, near the developing sink, will assist to carry off the fumes of the chemicals. Operating Room.

Two sinks lined with *gutta percha*, with waste-pipes of the same material, should be fitted *entirely separated* from each other; one for developing the picture, the other for standing the negatives in to steep in water, which should be laid on with several taps to both sinks. Gas likewise should be fitted along the sinks with *deep yellow* glass chimneys to the burners. Shelves for bottles, and a well-made *close-fitting* cupboard for chemicals, are wanted; at the same time it is especially advised not to make the shelves of the dark room receptacles for all the nameless rubbish apt to accumulate in such a locality, and thereby establish dust-traps to the certain deterioration or destruction of future pictures. Operating sinks. Water and gas. Shelfing. Cupboard for chemicals.

Let the dark room only contain those things which legitimately belong to it; let the shelves, &c., be washed frequently and kept free from dust, the sinks in the cleanest condition, and the floor covered with oilcloth, as being the material with the most unbroken surface and most easily purified from dirt. Necessity of extreme cleanliness.

It is imperatively necessary that not the *slightest* gleam of white light be allowed to penetrate into this room whilst operating; plates Precautions against white light.

Operating Room.

may be spoiled one after the other by a half open keyhole opposite them when draining, or by a forgotten cranny at the bottom of a door. Curtains to remedy this are not proper, they accumulate dust in their folds, and the movements on drawing them disperses its motes through the air of the room, to settle ultimately on the film; if the doors are leathered round it is quite as effectual in excluding light, and more cleanly.

Lead detrimental for sinks, pipes, &c.

Note, that if lead linings or pipes are used for the sinks, they will be acted upon by the chemicals, they will soon be full of holes, and the vapours of their combined action are most unwholesome.

ON CAMERAS.

Cameras.

In selecting a camera it is necessary to see that it is of the best quality, both in seasoned material and good workmanship; otherwise the patience of the operator will be severely tried, if his picture be not spoiled, by "slides" which will not stir, and "moveable bodies" which are obstinate fixtures; and by light—which in photography must be regarded as a destructive as well as producing agent—finding its way to the film, through many apertures besides the lens; these tribulations

Annoyances if badly constructed.

generally happening when some subject more important than usual is under treatment. CAMERAS.

Cameras vary considerably in their make, according as they may be destined exclusively for portraits and groups of figures in the studio, or being intended for landscape and out-door work, are made to fold together and be as portable as possible. Considerable ingenuity has been shown in the adaptation of all photographic apparatus to the purposes required, and in none more than in the manufacture of cameras, which have been constructed in so many ways, that the beginner may be puzzled to make his selection. I would advise him to eschew all idea of the purchase of a *cheap* or foreign one, as generally they are made of ill-seasoned wood, and are of inferior workmanship, in which a straight line appears to be the exception. Their various forms, and quality.

It has been customary to make cameras in the form of a parallelogram, so that if the operator wishes to make an upright picture, he has to fix the camera on its side, which is most objectionable, since not only are the difficulties of manipulation much increased, by the slides having to be worked from the sides, and never moving readily in such position, but the camera cannot be perfectly and immoveably fixed, and a confused picture is the result; all which, and the consequent vexation and loss of time, is obviated by pur- *Oblong* objectionable.

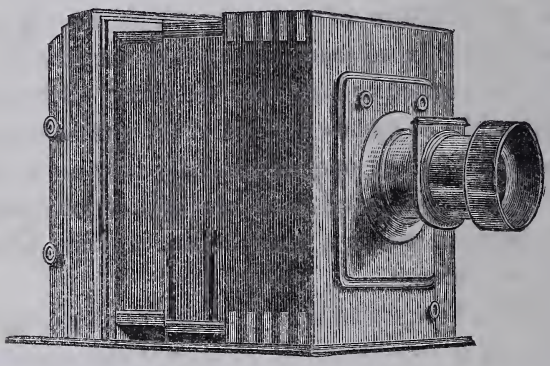
CAMERAS.

Square the best.

chasing a camera of a *square* form, in which, by means of inside frames, pictures of any shape and size, within its external dimensions, may be executed.

It will be unnecessary to describe many forms in which cameras are made; the smallest sizes are very simple and inexpensive; of the larger descriptions, fig. 23 represents one of *the best* arrange-

Fig. 23.



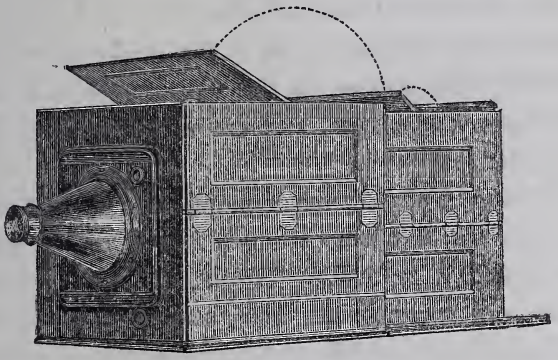
ments for portraiture, inasmuch as its construction with *two* sliding bodies permits lenses of several focal lengths to be conveniently used in it between the distances of six and twenty inches; it has sliding fronts which allow the lens to be placed in *any* position within the field; it has a *double swing back*—which all portrait-cameras should have—to allow a slightly inclined position to be given to the collodion film in subjects of difficult focus, or

Portrait camera described.

when "*short-focused*" lenses are employed for children, &c. CAMERAS.

For landscapes, out-door work, or foreign travel, greater portability than the above is requisite, which is best obtained by the "*folding-sliding*" construction, which, when packed, lies in Landscape camera

Fig. 24.



the compass of the first light line from the bottom in the woodcut. Here again, arrangements should be made, by the rising flaps shown, to allow a diversity of lenses to be used. described.

As it is desirable that several lenses should pass the same camera, it should therefore be made of sufficient length to suit the one of longest focus. The means of changing them with ease and rapidity is to have brass collars, called by the opticians "*adapters*," which screw into the front of the camera, and thus make up the difference between their diameters. Means of changing the lenses.

CAMERAS.

Desirable size.

An excellent size, for general purposes, is a camera with twelve inches square back and about two feet long; it is convenient, and portable, and can be used either for small pictures or at the full dimensions. If such a camera be furnished with two portrait or double lenses, of the diameters of about five and three inches, and two landscape-

With its lenses.

lenses, of about three and a half and two inches in diameter, the purchaser, if the lenses are well selected, will possess, in this department, a most satisfactory apparatus, and one well fitted for all purposes.

Having procured the camera, it will now be necessary to test it for two qualities; first, its im-

Tests of its perfectness,

permeability to light. Withdraw the ground glass, and covering the head and shoulders very completely with the focusing cloth, the lens having been capped, look into the camera and examine well for any crevice through which light may come; if none is seen it is perfectly sound, and the greatest aim must be to keep it so. Now test it to see that the inside of the focusing glass and the film side of the glass *in situ* in the slide accurately correspond. To do this focus carefully on an object with the full aperture of the lens, with exact precision, and take a small picture;

in different qualities.

if that object be not in the best focus of the negative, either the chemical and actinic foci of the lens do not correspond, or the construction

of the camera is defective, and the ground glass and collodion slide do not agree.

Whatever skill may have been shown in the perfect construction of the camera, do not for a moment suppose that it can keep out bright sunshine when full upon it out of doors; under these conditions it must be rigorously kept covered with a thick baize, and the collodion slide should also be wrapped up *in transitu* backwards and forwards to the camera, and the cloth cover kept over it in drawing up the flap. Never let it stand in the sun, no wood can resist that; nor in a draught between open doors and windows; its parts are thin and delicate, and will warp by such usage. Let it be removed, immediately after operating, from the glass room, where the variations of heat and cold are great. It should be covered with a thick woollen baize, and it and the collodion back should be well blotted from bath drainings as soon as study is finished. As before mentioned the contrivances for cameras are very various and numerous, but, provided the *workmanship is good* and the *material seasoned,* the more simple the arrangements the better.

Careful usage necessary.

Nature of precautions.

With respect to the cameras necessary to execute the *Stereoscopic picture,* it has been thought better, as they pertain very entirely to the different modes of treating that subject, that the description of the varieties which may be employed,

Stereoscopic cameras.

Cameras. according to the nature of the work undertaken—or the number of pictures simultaneously or successively produced—should accompany the section "Stereoscopic Pictures," as more necessary to its clear elucidation.

CAMERA STANDS.

Camera Stands. In order to place the camera at a proper height and position opposite the object proposed to be copied, it is fixed on a stand; these are usually

Their forms if portable. made of a tripod form, and are very various in their construction, according to the size and weight of the camera they are purposed to carry, and likewise whether intended for landscape and out-door work, or exclusively for use in the studio. The first are so contrived as to fold together and take the least possible space, but are not well adapted to carry cameras of large size, and even

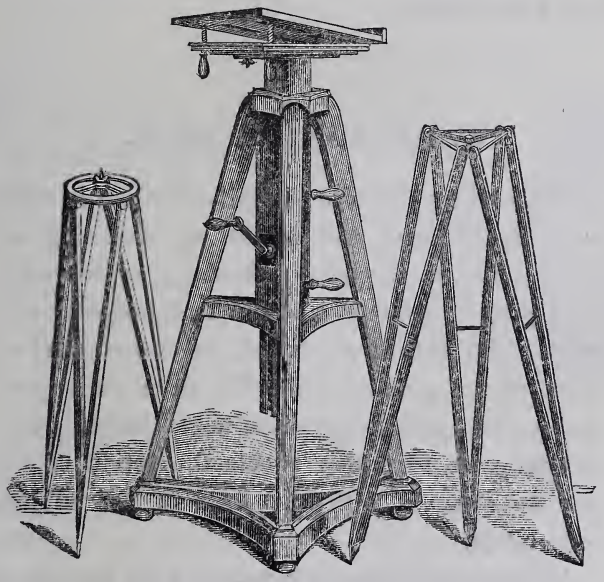
Liability to accidents. with the smaller sizes are very apt to upset by the overbalancing of the camera, the sway of the legs at the joints, or the action of wind; they will require precaution on the part of the novice to guard against these accidents, which are very damaging in their effects both on camera and lens.

Portrait stands. Those intended solely for working at home in portraiture, &c., are of a more solid construction,

which prevents their being liable to the inconveniences above described: the chief points to study in selecting are the power of placing, with the utmost facility, the camera at such height, distance, and inclination to the sitter, as the nature of the subject may require; and that when placed the camera may be so solidly attached and held, that not the slightest tremor is felt by it. These points

Qualities necessary.

Fig. 25. Fig. 26. Fig. 27.



have been found in practice, by the writer, to be very well provided for in the stand represented at fig. 26. There is a rack-work for raising and lowering, and screws to fix it when at the required

Preferable form.

CAMERA STANDS.

elevation; the castors allow it to be easily moved backwards or forwards, and the camera may be dipped as required by the movements of appropriate screws.

Safety of large.

The security and comfort in working is so great with the more solid stands, particularly with large sizes, that wherever practicable the student is advised to give them the preference in all subjects where the transport of them will not be found too inconvenient.

SWING CAMERA BACK.

SWING BACK.

Perfect command of position necessary.

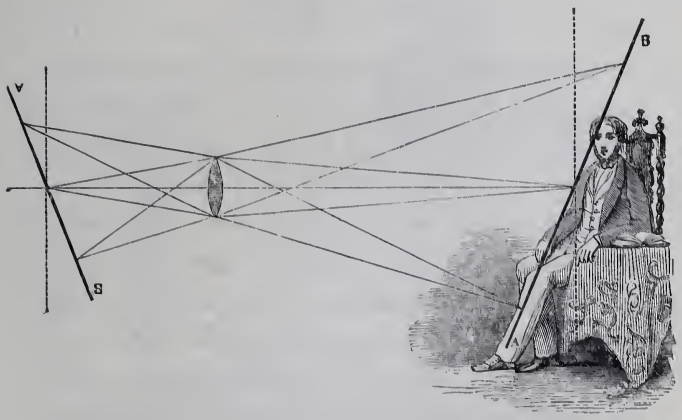
In operating with the portrait-camera it is most necessary to have the means of advancing or retiring it from the sitter, of raising or lowering it, of placing the *centre* of the lens opposite any portion of the field which may be desired, and of changing the position of the film from the precise vertical into such deviation of angle, laterally and vertically, as may best enable the action of the lens to coincide with the lines of the subject undertaken.

How obtained.

All these movements are provided for by various ingenious contrivances; castors, and rack and pinion movements on the stand, moveable camera fronts, with double action, to hold the lens and "*swing backs*," to carry the film, allow the opera-

tor to alter the distance and position of the field as may seem most desirable. The action of the swing back is intended by its motions to neutralize the distortion which results in using lenses of very short focal lengths, but it will also be found available and desirable with *all* double combinations. Its action is illustrated in the cut. Swing Back. Its use recommended.

Fig. 28.



On focusing any subject in which the lines are inclined from the direct vertical, as in sitting figures, &c., it will be found impossible to bring the lower projecting portions, as at A, into *perfect* focus with the upper retiring parts at B. Now, if the position of the film is judiciously altered by means of the swing back, the portions defective in focus will be seen to assume equally correct definition with the rest of the subject. This treat- Its action explained.

SWING BACK. ment also applies to subjects in which one or the other *side* is nearer to the lens, by slightly altering the lateral distances both sides come in focus. The operator can avail himself of *both* these movements simultaneously.

Allows *two simultaneous* movements.

HEAD RESTS.

HEAD RESTS. Unfortunately in photographic portraiture it is not possible to dispense with the use of this adjunct, which if not used by the operator with the greatest tact will infallibly tend to give a constrained attitude to the portrait—the best, indeed the only way to use it properly, is to let the sitter go into a natural position of the body and head, and then gently to advance the *crutch* until it just touches him. The writer was long much annoyed in *standing* figures, by the *sway* which there was in the body, which, although the head was supported, occasioned a *doubling of the lines* of the hands, figure, &c., more or less according to circumstances. In large portraits this is of considerable importance; as in these both the time requisite is longer and the movement more defined by the lens; if, on the other hand, the sitter makes an effort to maintain perfect quiescence, that alone gives rigidity to the *pose*. To obviate

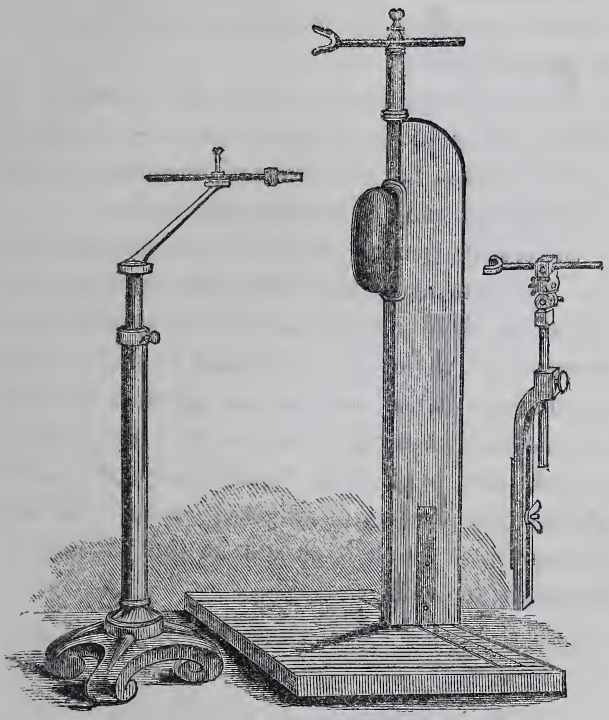
A disadvantageous necessity.

Form of, for *standing* figures.

these inconveniences the form of head rest, fig. 30, has been found very satisfactory. HEAD RESTS.

The stand is made of three-inch deal, also the upright, which is morticed into it. Strong angle pieces of iron are screwed on each side, and a T piece behind; a small cushion is firmly fixed for the back, and a short bronze head rest, *moveable* by screws, is fitted on the top. It is entirely free Strength and rigidity.

Fig. 29. Fig. 30. Fig. 31.



HEAD RESTS. from vibration, and the "sitter," *merely standing against it,* can turn in any direction and change his position as required.

For *sitting* positions. For sitting figures fig. 29 will be found more advantageous. It stands in any required position behind the sitter, and its adjustment is regulated with great facility.

The one represented in fig. 31 is made in wood, and is intended to attach to the back of a chair: it has the advantage of cheapness, but is very disappointing compared with the last.

Sitters in general disclaim all necessity for the employment of the head rests, and are confident in their powers to remain "perfectly immoveable;" the operator must not on that account discontinue its use, as failures and loss of time are the inevitable results. Still, as was before mentioned, the head rest, injudiciously employed, spoils many pictures, often giving an air of *leaning* or constraint which it should be the business of the artist to avoid.

Injurious qualities.

ON THE GLASSES.

GLASSES. Patent plate glass is the best to use for photographic purposes; it combines the advantages of flatness of surface and a high polish, both most desirable qualities to enable the collodion to flow

Desirable properties.

over it evenly and rapidly. The numbers 1, 2, 3, 4 (trade mark), being of different thicknesses, these may be ordered, increasing *pro rata* in thickness with the size of the plate, thus sparing unnecessary bulk and weight in the smaller sizes, and giving more strength to the large. GLASSES. Different thickness.

It requires to be properly and skilfully cut, as if carelessly done the operator will, from the same parcel, have some which will slip through the frame, and others which will not go in. They should be set on edge and rigidly gauged to avoid such annoyance, which generally happens when it is of most importance that it should not. Must be carefully cut.

The first thing to be done is to roughen the edges, which prevents the collodion easily running over the plate, in inexperienced hands, and enables the film to resist better the action of the water which it is necessary to pour over it, and it likewise prevents it from contracting at the edges. Edges prepared.

The writer has always done this by the application of emery cloth, which, if neatly manipulated, will at the same time take off the cutting edge of the glass, and leave a band of ground glass, some one eighth of an inch wide, on the margin of its top surface, to which the collodion film will firmly adhere, and which will save many disappointments. Mode of doing so.

It now remains to render the glasses perfectly

Glasses. and chemically clean. The writer has tried many of the recipes proposed for this purpose; he has had both baths deteriorated and plates spoiled by the obstinate adherence of some particles of Tripoli or other powders to the edges of the glasses, and has therefore discontinued the use of anything more than abundance of pure water, *running from a tap*, and a clean coarse linen rag to rub the glass with at the same time.

Care in cleaning.

Mode when new.

Still, as soap is used by the glass-merchants to mark the dimensions, &c., of their plates, it is a good precaution to wash the new glasses in a solution of common washing soda and warm water; and if they have been *previously used* they should lie for six hours or so in a strong solution of caustic potash, with thin slips of firewood between each, to ensure their surfaces being acted upon by the solution.

When used previously.

Manner of drying.

After washing under the tap they should not be put to drain, as even in drying thus they may take cloudy marks difficult to get off; but as each is perfectly washed it should *at once* be dried off with clean linens and carefully put away for use; they should be packed in dozens, standing vertically, in new blotting paper, and not suffered to come in contact with brown paper; nor should they be put in racked deal boxes, as they are sure to be acted upon at the edges in hot weather, by the contact of the terebinous wood, to the mani-

How to preserve.

fest deterioration of the subsequent film and nitrate bath. Indeed, even if packed for some time with clean blotting paper between each, held sideways to the light and breathed upon, the form and texture of the paper will appear upon their surface, so that it is not safe to operate upon any glass that has been long put aside, the better plan being to have it *fresh* washed for use. Of course, the impurities of a London or town atmosphere are prone to condense on the cold polished surface of glass, and the photographic glasses should therefore never be allowed to remain exposed to them.

Glasses. Precautions. Atmosphere of towns.

The cloths which are used to wipe these glasses should be of *linen* free from fluff; old table-cloths cut up well for the purpose. They should never be allowed to come near soap—they should be steeped in warm soda and water, rinsed abundantly in many waters, and hung up to dry, removed from all impurities. They should be *well-aired,* to avoid mouldy action, which is chemically deteriorating, and kept in well-closed drawers for use.

Glass-cloths. Mode of cleansing.

In proportion as the summer advances the difficulties of the photographer with his glass plates progress. The hands of his assistant will contaminate the cloths with the impurities of the skin, and from thence result the long smeary marks across the picture. Have six or twelve

Other precautions.

Apparatus. pairs of large common white cotton gloves, chemically clean, and, by a proper use of them, these annoyances will be avoided.

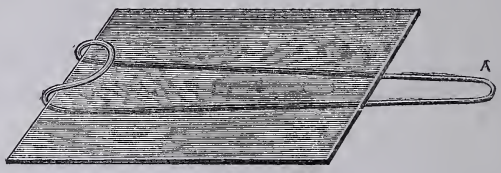
Just before wanted the glass is to be polished off with wash leathers or old silk handkerchiefs, prepared as the cloths. If the day is damp it may be held for an instant before a fire, but not long enough to *warm* it, which would act upon the collodion; if the atmosphere is dry, it is not necessary; all that is required is to *lose no time*, as vapour of the breath, &c. may condense on its surface, but when it is finished polishing proceed at once to lay the film.

Damp atmosphere.

DIPPERS.

Silver wire. The best dipper is a piece of *pure* silver wire, bent in this form, and where required to be joined,

Fig. 32.



which should be at A, not at the lower end, riveted not soldered.

It has several advantages. Its first and greatest, that it never breaks and disappoints the operator at home; or, what is worse, on a remote journey.

Advantages.

The jar of the metal against the bottom of the glass bath is less likely to crack it than the *glass* dipper would be; the plate neither slips off, nor in larger plates annoys by obstinately adhering to the dipper: it is cleaned with the greatest facility. It should be washed immediately after operating, wiped with a chemically clean cloth; if used in a slovenly manner it will turn black and be deteriorating to the bath solution. (Note, be sure that there is no *alloy* in the silver wire.) Apparatus. Clean condition.

The ordinary glass dipper is obtainable everywhere. Glass dippers

SCALES

Of some size, to weigh hyposulphite of soda, &c., in larger proportions. (These should have removeable concave *glass* disks to place in the metal pans, which preserve the chemicals from contamination by contact with the brass.) With glass disks.

Box of Scales, of less size, with *glass* pans, to weigh the smaller quantities of chemicals, up to one ounce. (Note, that great exactness and cleanliness are necessary in using these scales, as a small portion of pyrogallic acid, &c., adhering to them would suffice to spoil entirely a nitrate bath solution. When weighing out crystals of nitrate of silver, &c., it is well to cut two small squares of *filtering paper*, of precisely the same size, and place one in each scale.) Precautions. Precise cleanliness necessary.

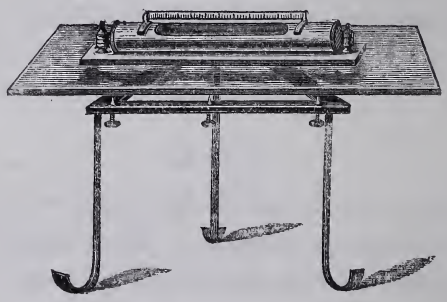
DEVELOPING STAND.

APPARATUS.

The usual and best form is the tripod, which is more easily adjusted to a level, by means of its screws, than the square; it is well to have two sizes for different dimensions of plates.

The best form.

Fig. 33.



To adjust it place a glass on the screws, and on it, as shown in the cut, the spirit level; having centred the "bubble" in one direction by turning the screws, alter its position to the opposite angle. The *level* is not perfectly attained until whichever way it is turned on the glass the bubble remains stationary in the *centre*. (Note, that it is necessary to the even flow of the developing solution that this should be accurately regulated.)

Mode of levelling.

PNEUMATIC PLATE HOLDER.

This ingenious little instrument can be procured at any of the vendors of photographic apparatus, it has the advantage of leaving the *edges* of the glass plate entirely free from contact, and consequently the collodion from contamination; motion is communicated from the *centre*, as from a pivot, and change of level is given to the plate in laying the film with greater convenience than in other methods.

Apparatus.

Advantages of its use.

SPECIFIC GRAVITY BOTTLE

Should be in the operating room of every photographer, since without it he will be unable to know whether many of the chemicals he employs are of the degrees of *strength* and purity it is requisite they should be; as, for example, the alcohol *absolute* and washed ether, which are in daily use, for adding to the thickened collodion, and likewise for testing other chemicals.

Its use necessary.

This bottle is of a globular form, with a *perforated* stopper, through which the excess of any liquid passes when the bottle is *quite* filled, thus ensuring exactness in quantity; there is a weight which exactly counterbalances the *bottle* itself.

Its nature;

Apparatus. The dimension is adjusted to contain precisely 500 grains of distilled water; if now the bottle be filled with alcohol *absolute,* which at 60° Fahr. is 0·794, or *newly washed* ether, which at the same temperature, barometer at 30°, is 0·725, on weighing, the contents of the bottle will show a result in grains which, multiplied by two, gives the specific gravity.

and mode of using.

GLASS BATH.

Used for nitrate bath. To contain the nitrate of silver solution nothing can be depended on, for chemical purity, but glass; heretofore the glass baths have been "made up" of several pieces of plate glass cemented together with marine glue, and much disappointment and annoyance have continually been experienced by their leaking, and the separation of their parts. Now *solid* glass baths are made on the Continent, which offer every advantage; they can be obtained to take plates up to the size of eighteen by fourteen inches. It is advisable to paste several layers of brown paper well saturated with paste round them, which, contracting as they dry, adhere intimately to the bath, and thus form a strong pasteboard case, which supports the glass, defends it from injury, and keeps light from the solution.

To be strengthened.

WEDGEWOOD TRAYS

Should be used *exclusively* for albuminizing and preparing plain paper, and holding the toning and fixing solutions; but those once taken for the two latter purposes should *on no account* be afterwards put to any other uses, since the nature of hyposulphite solutions is so searching that they traverse the entire structure of earthenware, as may be seen by filling a jug with them,—cottony efflorescence and crystals will soon form on the *outside*. Neither are these trays capable of resisting the action of the sixty-grain nitrate solution used in exciting paper, which should therefore only be put in a *glass* tray, as described. They are the cleanest and most satisfactory for steeping the proofs in water after they are toned and fixed; it is better not to have them too deep, and overcrowd the proofs, but to use *more* of the shallower ones, and thus separate them more effectually. The number and sizes required depend entirely on the nature of study undertaken.

Apparatus. Used for solutions. Penetrating nature of hyposulphites. Used for steeping the proofs.

Gutta Percha Trays have the great advantages of lightness and immunity from breakage, but are not proper to use for the exciting or toning solutions, since they impart an indelible though slight tinge of brown to the paper. They can be used with albumen, and to steep the proofs in water if desired.

Advantages and disadvantages.

DEVELOPING GLASSES, &c.

APPARATUS. Some quantity requisite.

Three dozen in *three* different sizes will be found convenient, and save much confusion in operating. They should be selected with *rounded* form of bottoms, to facilitate *perfect* cleaning, also the "punty marks" ground off and bottoms polished.

GLASS PESTLE AND MORTAR—is useful in reducing crystals to powder, and thus prepared they can be dissolved more readily when the operator is pressed for time.

GRADUATED GLASS MEASURES—1 quart, 1 pint, ½ pint, 2 ounce, 2 drachm, 60 minim. These measures and glasses will require great care in cleaning, that no trace be left of any solutions previously prepared or used in them, as a slight contamination of one by another would have serious results. The cloths used should be chemically clean, as those used for the glass plates.

Precautions to be observed.

GLASS SPOONS—are very useful in manipulating crystals of nitrate of silver, pyrogallic acid, &c., thus avoiding contact with the skin.

GLASS STIRRING RODS—of different lengths, for solutions (those used for nitrate bath solution to be kept strictly apart).

Of glass, and gutta percha.

FUNNELS must be of *glass*, and kept *strictly separate*, for the nitrate bath solution, and for the developing, exciting, and toning solutions. Two or three of gutta percha are useful for other purposes.

THERMOMETERS are very requisite, both in the operating room and glass studio, in order that the photographer may observe the temperature, and take means to equalize it as much as possible, by the use of blinds, evaporation, ventilation, &c., in summer, and stoves and hot-water pipes in winter; and that knowing the precise degree, he may arrange the strength of his developer, and make necessary calculations respecting time of exposure, &c., accordingly.

APPARATUS.

The exact temperature required.

RETORT STAND

Is of great convenience when preparing solutions, to hold the funnels as shown in the cut, thus avoiding accidents in the upsetting of the bottles, &c. When filtering into *measures* it becomes indispensible, to avoid personal attention.

Used in filtering;

Fig. 34.

in fusing chemicals.

In fusing any chemicals, and in various experiments connected with Photography, the retort stand will be found very useful to the practical photographer.

HORN TONGS

Apparatus. Are necessary to take hold of the corners of the paper in albuminizing, exciting, toning, and fixing; not only because contact with the fingers in the two first leaves stains on the paper, but also that to immerse them in solutions containing particles of metal, most minutely divided in hypo-sulphite of soda, as in the two last, is decidedly deleterious to the operator. Care must be taken to keep a pair for each purpose, and that those intended for nitrate of silver solutions are separated from those used in hypo solutions.

Prevent contact with solutions.

GLASS BOTTLES.

To select the proper descriptions, according to the uses for which they are intended, is of much more importance than might appear. There have been several collodion bottles contrived, some with a view to straining or filtering it from the deposit by percolation through sponge. &c., &c., but, no method for keeping collodion in perfect order for use is equal to the simple one of having one or two *very tall* stock bottles. The pressure of the column of collodion carries to the last half inch of the bottom all flue, dust, and fragments of dried film, which are very destructive agents in producing blemishes on the plate. It is easy to

Glass bottles for collodion;

their form,

decant *gently* from the upper portion into a smaller size for use, keeping the stock bottle replenished as may be requisite; the same treatment is equally necessary to be adopted with the varnish. Apparatus.

In order to appreciate the degree of failure avoided by these precautions it is only necessary to lay a film, or varnish a plate with the lowest strata of either bottle.

For works of any size, 20-ounce *tall* stock bottles, fourteen inches high, are not too large,—12-ounce for smaller sizes, &c. In laying the film, 6-, 8-, or 12-ounce, *two thirds full*, are good sizes; smaller bottles are convenient to preserve odds and ends of collodion, which all have their uses in the treatment of various subjects. and size

Observe, particularly, that the stoppers of these bottles are well and *evenly* ground in.

Ether, for the bath solution, and alcohol absolute, require *capped* bottles, and it is better that they should *not be large*, since when a large bottle is only half or one third full, the remaining portion is filled with atmospheric air, which deteriorates both the above, which are required in the utmost possible state of purity. Instead of one, it is better to have four or six smaller, carefully tied up and capped, to open as required. It will spare the chemical cupboard from unpleasant fumes if the use of capped bottles be extended for ether and alcohol; their requisites.

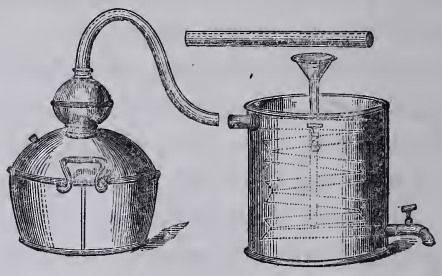
Apparatus. to nitric and glacial acetic acids. A few wide-mouthed stoppered bottles will be required for Other bottles. crystals of nitrate of silver, pyrogallic acid, &c., and ordinary stoppered bottles, of various sizes, for different solutions.

STILL.

Much distilled water is required in the process, especially when large sizes are undertaken. In cities, carboys of it can be readily purchased, and the time of the photographer not intruded upon by its preparation. When operating away from home a small still gives the means of being certain

To prepare distilled water.

Fig. 35.



of a supply. When the body is filled with water it is corked up, and put on a fire; the "worm-tub" requires to be kept full of *cold* water, which, as it becomes warm, is drawn off, and fresh added through the funnel. Rain water can seldom be

obtained sufficiently pure, being contaminated by contact with oxidised lead gutters, &c. Apparatus. Other expedients.

Clean ice melted gives very pure water, and may serve on an emergency.

SPIRIT LAMP

When operating away from home is necessary. If the atmosphere is damp it is advantageously applied *for a few seconds* to the back of the glass plate, just before laying the film; the moisture will be seen to leave the surface. When the negative is finished it affords the means of heating the plate previously to *varnishing* it, thus putting it in safety before returning home. Used in laying the film, and varnishing.

PRINTING FRAMES

Are used to place the negative, with the excited paper superposed, in the light. They should be purchased with *jointed* backs, to allow the progress of the action to be inspected. Note well that the thick front glass does not fit so tightly that it cannot be *easily* pushed out. This is a fertile source of broken negatives. These frames are exposed to great and sudden variations of temperature; and if the "thick plate" is jammed in tight, as is often the case, it is sure to be destroyed, and most probably the negative will share its fate. Their use, and liability to accidents.

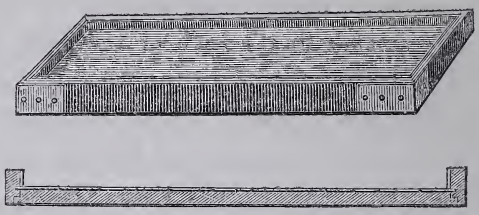
EXCITING TRAY.

Apparatus.

Of *glass* necessary.

No substance or surface equals glass for containing the sixty-grain solution of nitrate of silver used in exciting the paper for photographic printing. Gutta percha communicates a very distinct

Fig. 36.



brown tinge to the paper, indelible by the subsequent processes. The glaze of Wedgewood ware cannot withstand the action of the solution, which traverses its structure, and the surfaces of both are deficient in evenness. The only mode of obtaining glass trays for this purpose is to *construct* them of plate glass, as it is not possible to procure them of any size in one piece. The method given in the cut has the advantage of giving support, by the wooden casing, to the glass plates, thus keeping them in their form and preventing risk of external injury. It is necessary that the casing should be made of *well-seasoned* mahogany, otherwise the very means taken to protect the glass would, by the shrinking of the wood, destroy it. If

Others deteriorating.

Wooden casing.

a white millboard or paper is put on the wood by the maker, previous to the *bottom* glass being placed, it will enable the operator to detect with more facility any impurities which may be in the solution or on the surface of the glass. APPARATUS.

FOCUSING CLOTH, &c.

A piece of the thickest black cloth procurable; held up to the light it should not allow any to be seen; it will be found to adapt itself better to the movements of the operator than the India rubber cloth, sometimes recommended for this purpose, which, however, should always be taken as well for *outdoor* work, as it saves the camera, &c., from rain. Straps or India rubber bands are useful, and some squares of yellow and black calico, single and double, are very handy. Quality recommended. Serve other purposes.

FOCUSING EYE PIECE.—Is of great utility, it enables the operator to examine the definition of the picture on the ground glass screen, and to determine the exact focus with greater accuracy than is possible with the unassisted eye. Importance of it in focusing.

LINEN CLOTHS, for cleaning the glasses, are better of *old* table-cloths, napkins, &c., than of *new* material. Some pairs of *large* white cotton gloves for the assistant who polishes the glasses. Some *old* silk handkerchiefs and some wash-leathers; the whole of the above must be rendered The qualities required.

Apparatus. and preserved *chemically* clean, as described article "Glasses." Two or three *very soft* wash-leathers, the dust well beaten out of them, *not washed,* to clean the lenses.

TEST AND FILTERING PAPERS.

Use of test papers. Litmus paper is required for testing the nitrate bath, toning bath, &c.: filtering paper *of the best quality* for the nitrate bath and solutions, and abundance of new blotting paper for the manipulations.

Note, that the foregoing is a list of *complete* apparatus proper for executing works of importance; it is easy to suppress some items, and diminish size in others, should the nature of the study undertaken not necessitate them.

PART III.

MANIPULATIONS.

PREPARING THE CAMERA.

BEFORE placing the film in the camera, it is necessary that the latter should be in every way prepared to receive it, and all precautions taken which may insure a successful issue.

Precautions necessary;

The lens must be perfectly polished with its appropriate leathers—the *inside* of the camera carefully dusted—the exact distance from the subject fixed, and the *size* the object or objects appear, and the *position* they occupy in the field found satisfactory—the height and inclination of the camera decided upon—and the necessity, or otherwise, of using the swing back and moveable fronts studied—two or three diameters of diaphragm must be tried, and their effects on light and focus observed. These preliminaries having been attended to, we next proceed—

their nature.

TO LAY THE FILM.

MANIPULATIONS.

The glass plate, having been scrupulously cleaned according to the directions given, is put on the pneumatic holder, and the trigger being drawn down into the catch, the glass is fixed in its place: its surface must be well polished with an old silk handkerchief at the last moment that the operator is ready to lay the film. Observe that all doors and windows are shut; the ether is sufficiently rapid in evaporation, and draughts disturb the air, raise and bring in *dust*.

Currents of air injurious.

If there is much humidity in the atmosphere, it is well to hold the surface to be operated upon, for a *few seconds* only, before the fire or over a spirit lamp; the moisture which had condensed on the glass will be seen to leave it.

The stopper and neck of the collodion bottle being carefully wiped from the horny crusts of former pourings, take the holder firmly in the left hand, raise the plate to the height of the chin, that the eye may readily appreciate the flow of the collodion, hold it *perfectly* level, keep it at arm's length, and especially refrain from talking and breathing over it, as the moisture of the breath becoming condensed on the surface of the glass, would seriously deteriorate the film.

Mode of holding the plate,

Now, lowering the mouth of the bottle down

within an inch or so of the glass to avoid bubbles, splutterings, &c.,—to do which the bottle must not be more than two thirds full—pour *firmly* and *steadily* in an even stream—without pause or jerks —until there is sufficient collodion to cover the size of glass that is being operated upon. Practice will soon determine the quantity necessary, which is about three fifths of the entire surface; the student should hasten to acquire this knowledge, as if too little is poured on the glass, loops and streams will be formed, encircling bare glass, and the latter then becomes most difficult to cover evenly.—If too much is poured out, collodion will probably be wasted by running over, in getting the superfluous quantity back into the bottle. A few trials will give *firmness*, neatness, and quickness to the manipulator.—The best way in covering a plate is that in which the collodion has only to travel *once* over the same surface, and not, as it were, form a second strata, by returning over part of the half set first, to the pouring off corner.

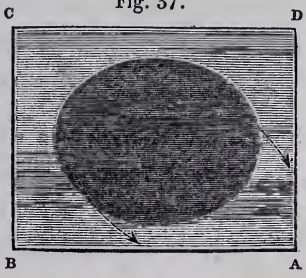
MANIPULATIONS.

and pouring the collodion.

Quantity necessary.

To accomplish this is most simple; in pouring it is easy to give such a slight motion as shall cause the pool of collodion to assume an oval instead of a round form. Fig. 37

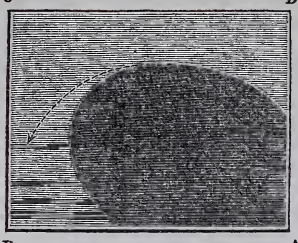
Fig. 37.



Mode of covering.

MANIPULATIONS.

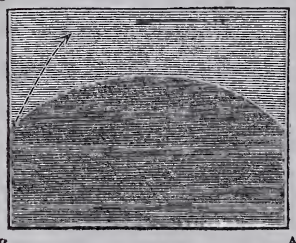
Fig. 38.



having sufficient, stop pouring—a depression of the corner A will bring the collodion to the edge, in the form shown (fig. 38); on lowering the corner B the collodion flows to it, and there is, as shown in fig. 39, now only one motion, of a slightly rotary kind, which sends it at once both to complete the corner C, and to D, which, being inserted in the mouth of the bottle, the surplus is poured off gently, not *raising the glass* above an angle of twenty-five degrees,

illustrated.

Fig. 39.



as if held up vertically, or at a greater angle, reaminess and striæ will form which cannot be got rid of; rock it *gently* from C to A, to antagonize the current from B to D, and thereby render it even; if this is done violently in jerks the film

Rocking the plate.

will be cracked. As soon as it has done running, in hot weather—or after it has stood a few seconds *horizontally* in cold; take it from the holder, place it on the dipper, still keeping it nearly *horizontal* in position.

MANIPULATIONS.

Afterwards placed horizontally.

EXCITING THE FILM.

Now, observing that *all white light is strictly excluded,* advance to the mouth of the bath, and with one *steady even movement* lower it to the bottom; should any pause take place there will subsequently appear straight lines of stain, from side to side, across the negative; if the film is dipped too soon, in cold damp weather, reticulated fissures in the film will probably appear; if kept too long, before placed in the bath, blank patches of insensitiveness will result; besides the qualities of temperature and atmosphere, the nature of the sample of collodion must be taken into consideration: a thick viscid collodion will require twice as long before dipping as a thin subtile one, and if subjected to precisely the same treatment both would be spoiled. The time requisite to leave the film in the bath varies with the temperature, requiring much longer in cold

Dipping into the bath.

Time required.

MANIPULATIONS.

than in hot weather, and the plate may be left longer in a bath which has been some time in use than in an entirely new one—two to three minutes is a mean time. After it has been a minute or so in the bath, *but not before,* it should be gently raised and lowered, some five or six times, to even the action of the iodide, and then left to complete the time proposed. Now raise it gently, if all oily streaks have disappeared, and the surface appears even, it is ready; hold it a moment at the mouth of the bath to drain, then put it upright on a strip of *clean* double-blotting-paper, leaning the back against a bottle; when it has stood from five to forty seconds—again by temperature and area of surface—to drain, place it in the back or slide, at the four angles of which small pieces of *clean* blotting paper should have been placed to receive any moisture, and covering the back of the glass with blotting paper, close the slide and get it to the camera and in action as rapidly as possible, since delay has the effect of diminishing its sensitiveness by drying the film.

Varies with temperature.

Plate drained.

Ready for the camera.

TO EXPOSE THE FILM.

MANIPULATIONS.

In taking the slide or back from the operating room, or returning from the camera, be careful not to *reverse* or *alter its position* from the vertical, in which it stood during exposure; some bath drainings will be sure to accumulate at the bottom, which, contaminated by contact with the slide, would, if it were not held in the same direction, run back over the film and stain it. If operating from the life, focus *at the last moment* before putting the slide into the camera.

Position of the slide.

Now remove the ground glass, replace it with the collodion back, cover the top of the latter, and keep it scrupulously covered with the focusing cloth, otherwise light *will* get to the film, and uncap the lens without shaking the camera. The time of exposure expired, cap the lens, observe that you lower the sliding shutter *very gently*, if done otherwise the bath drainings at the bottom will be splashed up the film, and the negative spoiled.

Precautions to be observed.

TIME OF EXPOSURE.

MANIPULATIONS.

In the whole range of photographic manipulations the sum of which goes to make up the perfect picture, there is not one of more importance than the correct time of exposure in the camera.

Its great importance.

Fixed rules impossible.

No fixed data can be given for duration of exposure, since occasionally the subtilty of the changes between very short intervals of time may render one negative intense, and the one immediately following it weak and defective, with the same treatment. Still, by practice, a sort of instinct grows on the photographer, which often leads him to alter on the moment a predetermined thirty seconds into twenty, or *vice versâ, after the film is uncovered,* according as the quality of the light may have impressed him during the operation.

The only general rules to assist our estimate of the actinic power are the following, which experience has shown to be the conditions most favorable to the production of the photographic image; namely, the time of day, as near the meridian as may be; the purity and freedom from vapours of the atmosphere immediately on the earth's surface; which, to estimate it pro-

The most favorable conditions.

perly, requires the command of an extended horizon. The time of year—spring and early summer, with a *moderate* temperature—sixty to seventy degrees Fahrenheit—not that it is the writer's opinion that the action of a *low* temperature is entirely deteriorating to the exposure *in the camera;* as during clear frosty weather, unaccompanied by vapours, he has made satisfactory negatives—failure seems more to be caused by the effect of cold upon the chemical agents used in the process, which impedes or arrests their sensitiveness. When this has been carefully guarded against in *clear* weather, in December and January good actinic quality has been experienced. The temperature of the glass house and dark room at such times must be raised, by fires and hot-water pipes, to sixty degrees Fahrenheit, and in the temperature the bath, the developer, the collodion and the glasses, which are to receive the film, must have been kept a sufficient period to acquire the same heat; likewise the camera and lenses; for should they have been brought in from a lower temperature, the vapour from the collodion film would, during the time it was uncovered, be condensed on the lens, and interfere with its action.

MANIPULATIONS.

Temperature.

Effect of cold.

The chemicals, &c., being protected.

Now, although cold weather does not, with these precautions, prevent good and vigorous negatives from being executed; extreme heat has

Effect of heat.

MANIPULATIONS.

a very damaging effect, against which no efforts of the photographer will avail; its influence is not only felt in the exposure, but by the chemicals of which the nitrate bath and collodion are the two most deteriorated in their qualities; this will be found treated of under the head Nitrate Bath, and Collodion. The writer has observed that the action distinctly improves after rain has fallen, whether during the bright intervals between smart showers, or the morning after a more continuous fall; occasionally, even during heavy rain, the action has not been impeded.

Other influences.

But the process is retarded, and the action is often entirely deficient in hot sultry weather, in which the atmosphere is surcharged with electricity; a thunder-storm will at once restore excellent photogenic qualities. Elevation of ground is decidedly favorable.

Negatives under-exposed.

Photographers in general more often commit the fault of under than over exposing their negatives; now it would be desirable to reverse the error, and, if we cannot hit the precise moment of time, that they should, of the two, be over-exposed, since in the former case the result is absolutely valueless; in the latter, we have two favorable chances; one, that if skilfully manipulated, it is in our power suddenly to arrest the progress of the development at a point which shall retain most of the qualities necessary to its printing

successfully, the other, that some subjects do not lose by a *slight* over-exposure; it often gives atmosphere and sunny effect in landscapes, and with some arrangement, delicacy to female portraiture. Indeed, it is more than doubtful whether the greater portion of the most successful results which we see are not more consequent upon this balance of exposure and development, than to the exact timing, to a second or two of exposure. Not that it is possible to produce a fine picture if the exposure has gone beyond a certain limit; the nearer we hit the correct time, the better the result, but of the two errors over-exposure is the less fatal.

MANIPULATIONS.

Over-exposure.

Its results.

Correct.

TO DEVELOPE THE IMAGE.

The slide having been brought back to the dark room from the camera, we now proceed to develope the picture. The strength of the solution to be used must depend upon the temperature; when that is high, as in summer, it is advisable to reduce the developer by adding two parts of distilled water to one part of the three grain pyrogallic solution; in medium weather, thermometer 60° to 70°, one third water to two thirds of solution,—and when the temperature is below 60°, using the full strength. Take the glass

Strength of solution.

Dependent on temperature.

MANIPULATIONS.

carefully from the slide by the edges, avoiding touching the film, place it on the developing stand; now take one of the developing glasses, in which, just before going out to the camera, the solution should have been prepared—a larger one, half full, *depresses* and *spreads* better than a small one full—quickly and skilfully pour the developer, as much as possible at one motion, all over the film, avoiding especially pouring it in one place—now put down the empty developing-glass, take the plate by the two nearest corners, and rock the solution rapidly but *gently* backwards and forwards, —if necessary, from portions of the surface remaining uncovered, and not flowing readily, blowing it at the same time. At first, particularly with the diluted solution, it will have a great tendency to draw together in uneven greasy patches, but it must not be allowed to rest, otherwise there will infallibly result stains and blemishes,—after a short interval it will lie smoothly on the film.

Mode of application.

Its action described.

If properly exposed, in medium temperature, the picture should begin to appear in ten to twenty seconds; at this point the experienced operator knows, at a glance, the quality of the negative. Should the image dash out immediately the developer is applied, it has been over-exposed—it may be irrecoverably so; in which case a general decomposition immediately ensues.

Appearance of the image.

Treatment if *over*-exposed.

If it has been less, be quick to stop the action with water, which must always be at hand for the purpose. Over-exposed negatives, when held up to the light, show a want of vigour in the deposit on the high lights, and a tendency, more or less, to general indistinctness from fogging. If it is desirable to increase the intensity on the high lights, and to clear the darks, proceed as follows: Apply the saturated hypo fixing solution, when the yellow iodine is gone, wash *well* with plain water, and after rinse with *distilled* water; now placing the negative again on the stand, apply fresh developer, of full strength, with some drops of bath solution decomposed in it; the result will, of course, not be so good as if correctly timed, but generally this expedient will improve a weak over-exposed plate; wash, apply the hypo sol., and steep in water. If the exposure has been faulty, by being too short, the image will appear very slowly, the more so as the light was inefficient or the exposure defective; the white lines first alone, after the high light on the face and hands appear; the parts in shadow and dark draperies being entirely neglected, are the signs of such a plate, which is totally worthless, except to serve as a guide for rearranging any parts of the composition which may appear defective, and to regulate the exposure of the next film.

MANIPULATIONS.

Fogging.

When *under*-exposed.

If the exposure has been successful the white

MANIPULATIONS.

When successful.

and light draperies, the head, hands, &c., will be well supported by other forms, and even in the dark local colours, as of dress, hair, &c., drawing will appear; the development should be stopped when all but the *very deepest* shadows, the pupils of the eyes, &c., are filmed over, the latter should remain *near* bare glass; if taken precisely at this point the picture will have spirit, rotundity, and variety of tones, from the most delicate tints of shadow on white to *small portions* of vigorous and spirited black, which will not only give the necessary scale, but will likewise produce form and give atmosphere to the subject. It sometimes happens by certain combinations of temperature, light, or both, that although the exposure may be correct, and the gradations are satisfactory in the picture,

Deficient in intensity.

the deposit is not quite sufficient in intensity; in which case a few drops of bath solution added to the developer will improve the negative; but it is necessary to remember, should the appearances on the glass be *almost right*, that if this operation is injudiciously performed the half tints in the

Adding bath solution liable to deteriorate the picture.

flesh of a fine head may be rendered opaque and spoiled, that the decomposed nitrate of silver has decidedly a tendency to attach itself more *pro rata* to the high lights than to the parts which have been less acted upon in the camera, and that if such a solution is left on the subject more than a few seconds a general muddiness, irrespec-

tive of all forms, makes its appearance, and the brilliancy of the subject is gone. MANIPULATIONS.

If the subject is *large*, it is well to commence with the dilute solution, as being less liable to cause stains, from its slower action and giving more time to cover the film evenly. When the greasiness before mentioned has disappeared, a stronger developer may be applied with less risk. Developing large sizes.

Should there be in the composition strong opposition of local colours over which the operator had no control, and which would be likely to come out spotty, as, say, a white cottage in a landscape, or very light or dark draperies in a figure subject, an expedient may be resorted to which, if skilfully manipulated, corrects the exaggeration of such parts. Useful expedient.

The developer must be used of one-grain strength, and must be moved until it lies quite evenly; two chemically clean glass syringes must have been filled, one with distilled water, the other with three-grain solution; now a few drops of these into the floating one-grain solution respectively, over the too white or too dark parts, will retard the one and advance the other.

Generally it is better, if the subject is not too large, to develope smartly, there is decidedly more spirit in the result than there would be by manipulating slowly with a weak developer; but, of Better to develope smartly.

MANIPULATIONS.

course, the operator must then be more watchful to prevent stains, by keeping the plate in motion.

Too small or too large a quantity objectionable.

It is objectionable to use too small a quantity developer on a plate, the chances of stains are infinitely increased. It is also not desirable to use so large a quantity that it runs off the plate, as then it carries with it the silver which was in the film, and which was necessary to form the image.

APPEARANCES OF THE IMAGE WHEN DEVELOPED.

The developed picture, viewed by transmitted light, differs in its appearance, even when possessing equally favorable printing qualities. There

Varieties of colour,

are variations of colour in the image, and of real or apparent intensity of deposit, which are caused by the changes and relations towards each other of the bath and collodion, as the acidity or neutrality of either the one or the other predominates. Likewise, independently of duration of exposure, varieties of appearance are caused by changes in the quality of the light; often in the same locality, on the same day, with the identical chemicals, negatives differing in translucence or

and opacity;

opacity and *colour*, are produced; but which may,

notwithstanding their varied character, all have equally favorable properties. The negatives taken with a bath prepared with acetate and carbonate of silver, are especially distinguished by a great range in their colours, from a pale inky black, through dark blue-blacks, browns, and marones, to deep reds.

MANIPULATIONS.

the causes.

The *best* printing qualities for a negative to possess are the following: the high lights in the picture, that is to say, the most intense portion of the deposit, should allow the flame of a candle to be *just seen* through when held behind them; if of too great an opacity to admit its being perceived *at all*, the resulting positives will probably be chalky and bare in the lights, and deficient in half tones. There should be a *general* deposit of silver, with *considerable variations of intensity*, over the whole surface, with the exception of the most vigorous darks, and in them it should approach *very nearly* to the bare glass, but *only in small portions*, if in large masses it would denote under-exposure. Held up to the light, their colour should be of a warm inky brown; when the plate is held horizontally over a dark ground, and viewed by diffused light, the appearance which especially distinguishes the deposit on the film in all negatives of the highest capabilities is an earthy *drab colour*. Such negatives are sure to print well, all the objects represented

The best qualities

in a negative described.

Colour by transmitted light;

by diffused.

MANIPULATIONS.

by them will be *rotund* in appearance, because their forms are thoroughly delineated by delicate half tints, and the extremes of light and dark, with all the *intermediate tones,* will be well expressed. Their effect will be bright and spirited, equally removed from the vapid monotony of *over-exposed* negatives, which are deficient alike in both whites and blacks, and from the crude and misshapen forms of the *under-exposed,* which fail, because wanting the softening beauty and *drawing* given by middle tints.

Possesses every gradation of tone.

Compared with imperfect.

"Assisted" development.

When the negative has been assisted, in an inefficient exposure, by the addition of drops of nitrate bath to the developer, the peculiar drab colour of high actinic quality will not appear when examined by diffused light; in its place, darker tones and more opaque deposit of a *blue* or *black* character are seen. They are less satisfactory, being deficient in the truth and delicacy of gradation possessed by the former, and are apt to be very deceptive when printed; dark and vigorous looking negatives occasionally allowing the light to permeate through their texture, whereas the most translucent of these impressed under favorable actinic conditions have a great power of resisting it, although their weak looking, light brown deposit, would appear ill adapted to do so.

Defective, and why.

FIXING THE IMAGE.

MANIPULATIONS.

Having been thoroughly washed from the solution, the developed plate must now be *fixed*. The most convenient mode of doing so, for small and moderate sizes, is to have a gutta percha bath, with glass dipper, containing the hypo fixing solution; the plate is immersed in it precisely as it was in the nitrate bath. After the lapse of a short period it is raised, and if any of the yellow iodide remains undissolved it is returned to the bath. If it appears *entirely* cleared, it is taken off the dipper and laid on the film upwards to steep in water. Common jelly-pots make excellent rests to stand the plates upon in a sink. The quantity of water depends on the size of the plate. A pint for the *smallest* size, in four intervals of a quarter of an hour each, will suffice; for the larger, two or three quarts in the same period. If they are inefficiently washed the hypo will not be dissolved out, and remaining on the film, will make its reappearance in crystals, to the certain destruction of the picture. If the sizes are large, or it is not wished to have a bath expressly for the fixing solution, the best mode of applying it is as follows: take a large Wedgewood tray, stand in it four jelly-pots bottom

Convenient mode of fixing.

Iodide must be entirely removed.

The film well steeped in water.

Another mode of fixing.

MANIPULATIONS. upwards, place the negative on them, and pour the hypo on it from a jug; the solution is not wasted, being returnable from the tray. In adopting this mode, it is proper that the jug used should have a perforated strainer in its spout, which will intercept any crystals of hypo fragments of film, or other impurities, which would drop on and mark the plate.

VARNISHING THE PICTURE.

The negative must have been sufficiently washed

Hypo solution removed. with clear water, so as to have removed *every trace* of the hypo fixing solution from the film; at the same time it is not advisable to allow water to remain *too* long, as it then seems to weaken the

Precautions. film, and cause reticulation. In the summer weather beware of the flies, who appear to have a great propensity to settle upon and mark the film, and of the dust, which is likewise injurious. Let the subject be placed upright, facing the wall, on a slip of clean blotting-paper to absorb moisture; see that the varnish bottle is clean in the mouth, a twelve-ounce tall collodion bottle makes the best varnish bottle, as the weight of the column of varnish tends to sink any impurities to the bottom, and the upper and clearer portion only will be

used. Now hold the negative with the back towards a good fire, or if from home over a spirit-lamp, not too near, however, and move it gently, so that it may be evenly heated. This operation, particularly in cold weather, must be performed carefully, or the glass may fly. Having heated it so that the hand can just be borne comfortably on the back of it, take hold of the corner with the fingers and thumb of the left hand, and pour the varnish on the centre of the plate, send it from corner to corner, precisely as the collodion film is laid, and pour off into the bottle. It should not be held *vertically* to drain, which would cause ridges and inequalities on its surface, but must be treated precisely as directed for laying the collodion film: when *nearly* set, it is well to stand it on a slip of clean blotting-paper, which will absorb any varnish, which would form a ridge or "fringe" at the bottom of the plate, and be detrimental when printing.

MANIPULATIONS.

Negative heated.

Mode of applying the varnish.

If the glass is *over-heated*, the results are that it will possibly fly when the cold stream of varnish is poured on it, or it will seeth in bubbles on the surface; and such a negative, when dry, is sure to be destroyed by the varnish cracking and rising up in scales, bringing the collodion film away from the glass with it. If the plate has been *insufficiently heated*, the varnish will "chill" in drying, and its *opacity* will seriously interfere with

Effects of over-heating,

and insufficient.

MANIPULATIONS.

the successful printing of the subject. The best varnish to use for this purpose is a spirit-varnish, manufactured in Paris, it is the 'Vernis Soehnée,' and is retailed in London by most of the dealers in photographic apparatus.

Vernis Soehnée.

Amber varnish.

The amber and chloroform varnish cannot be recommended, its powers of adhesion to the plate are too weak; but the writer has known it to stick to the fingers, with part of the subject from the margin of the plate attached, long after carefully finished; for out of door work it may have advantages, when a picture is required to be immediately varnished, as the glass does not require to be heated for its application.

Treatment of damaged surface.

If a negative has been printed in the direct sun-light, and has had its varnished surface injured; by placing it on the developing stand, carefully levelled, and allowing chloroform to remain upon it a few minutes, the injured surface will be dissolved, and it can be revarnished when dry; this applies equally to both the above varnishes. Observe that a few hours should be allowed to elapse before printing from the newly varnished negative, or it may probably suffer by adhesion to the paper.

DEFECTS,

THEIR CAUSES AND REMEDIES.

Having described the *favorable* appearances in the deposit of silver on the plate, we will now proceed to examine the *imperfections* and show their nature and origin, and this portion of his experience is of as much or more value to the operator as any; for in a process consisting of a great variety of manipulations, on the *complete* success of EACH of which the perfection of the resulting picture is dependent, it becomes of great importance to possess the power of distinctly referring any failures to their *exact* origin, and thus being enabled to apply the necessary cure. Otherwise, the student would have the mortification of seeing plate after plate appear on development with the same blemishes, to which, having been unable to trace their source, he would be incapable of applying a remedy.

Manipulations.

Defects; importance of analyzing,

and tracing to their source.

It is well, therefore, to acquire the habit of *never passing an imperfection,* and not resting satisfied until in all the various processes the *one* causing it has been discovered.

The first defect we will notice is of frequent recurrence; it is a general obliteration of the forms of the subject in an *opaque film,* which

Opaque film.

Fogging. prevents them from being clearly distinguished, in whatever direction they may be viewed. This "Fogging," its causes. is termed "fogging," and is caused in a variety of ways. It may result from the unskilful use of the Over-strong developer. developer itself; if it is of too great strength in warm weather, when it should have been reduced in power by the addition of distilled water, fogging will ensue; or, at a more moderate temperature, prolonging the time of development beyond a certain limit, will cause the same blemish. If weakening the solution in the one case, and shortening the development in the other, does Nitrate bath alkaline? not remedy the evil, the nitrate bath must be tested for alkalinity with *reddened* litmus paper.*

If its condition is found satisfactory, *i. e.*, *neutral* or *just* acid, which will be seen by its allowing the reddened litmus paper to retain its colour, the fault is not there. If it restores it to its Remedy if found so. former tone it is *alkaline*, and a drop or two at a time of acetic acid must be added; *testing between each change* with the *blue* paper, so as not to exceed the quantity necessary, which will be when the paper is tinged with *red*. Stir with a glass rod

* Litmus paper, when used to test for alkalinity, is first reddened. This is best done by taking out the stopper of an acetic acid bottle, and holding a strip of the paper in the *fumes* inside; it will immediately change from blue to red. Actual *contact* produces a less sensitive test paper, its texture being completely saturated with the powerful acid.

during the time, that the drops of acid may be equally distributed *throughout* the bath solution, and their action not confined to the mere surface. Fogging.

When there is only a *very slight* tendency to fog, it is better not to touch or alter the bath; by using a more highly coloured sample of collodion perfect clearness of definition will be restored to the film, whilst at the same time every plate of such quality of collodion that is dipped will tend gradually to displace, more and more, the small tendency to alkalinity existing in the bath. *Very slight* fogging.

Indeed, with such a combination and balance of properties, an *acid* collodion and a *neutral* bath, most excellent qualities are produced in the picture; the bath, on the one hand, possessing the power to accelerate the action and delineate the difficult colours or obscure radiations from the subject; whilst its inclination to fog is bridled by the acid state of the collodion, which keeps the general definition of the plate and its darks and half-darks bright and clear. Excellent combination.

Should the bath, when tested, be found in good condition, the fault may be with the acetic acid; if it is deficient in strength it will not moderate sufficiently the action of the pyrogallic in the developer, on adding about a sixth to one quarter more than its original proportion to the solution clear plates will be obtained. When not arising from these sources, fogging may be caused by Acetic acid deficient in strength.

FOGGING. Diffused light, and reflexions.

diffused light having acted upon the film either in the operating room, the slide, or the camera, or from the reflexion of light from *bright surfaces* in the studio, or portions of sky acting directly on the lens.

An old bath.

An *old bath* has occasionally a tendency to fog, from the accumulation of organic matter and presence of oxide and *nitrite* of silver; the best remedy in this case is to replace it by an entirely fresh one.

Over-exposure,

Lastly, and more frequently than any of the preceding causes, *over-exposure* at *large apertures* of double lenses is a fertile source of this imperfection. One general line of demarcation exists in fogged plates, which materially assists the operator in discovering the origin of the evil; it is that when fogging proceeds from impurity in the chemicals it is *on the surface*, and is removable by gentle friction with the finger. If it has been produced by over-exposure or diffused light it is *in the body of the film*, as much as any portion of the subject itself, and is incapable of removal.

Means of ascertaining

Insensitive film.

The next blemish we will notice, is the direct opposite to the fogged appearance on the plate: it is the insensitiveness evidenced by the too great quantity of *bare glass* seen on the plate, this is caused probably by *acidity* of the bath, which must be tested for it; if there, its presence will be

denoted by the greater or less degree of intensity of the *red* colour which it imparts to the litmus paper, and according to the proportion, so must the quantity of the alkali, applied to rectify it, be regulated. Some operators recommend ammonia for this purpose; the writer advises drops of a solution of carbonate of soda, dissolved in distilled water, to be used in preference, having found it in practice give much better results. It must be applied very gradually, and the test-paper and stirring-rod used as mentioned before.

INSENSITIVE

Bath tested for acidity.

If on testing the bath its acidity is not considerable, and the operator has been working it with a rather highly coloured collodion, instead of meddling with the bath the *balance* before mentioned can now be restored in the contrary direction—namely, by using the most *neutral* sample of collodion at hand, which will be found as efficacious in restoring sensitiveness, and giving delineation of forms in the bare portions of glass, as the acid collodion was in clearing the obscured plate.

Over-iodized collodion.

If the bath is not in fault, the *exposure in the camera* has probably been of too limited duration, or the *diameter of aperture* less than the quality of light would bear; increasing the time of the first, or enlarging the other, will entirely alter the character of the succeeding plate.

Too short an exposure.

Reaminess or wavy marks are most likely to

Waviness.

RETICULATION.

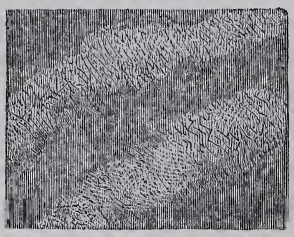
Collodion too viscous.

occur in thick viscous samples of collodion, which are difficult to get off the glass with sufficient celerity; in hot weather *all* collodions will be apt to have this defect, owing to rapid evaporation of the ether in manipulating.

This unevenness is most offensive in large flat tints, backgrounds, &c., with whose perfect appearance it of course greatly interferes, but it is highly detrimental and objectionable in *all parts* of a picture, for as the *thickness* of the collodion film is *doubled* in such parts, *no treatment* which will apply to them will be successful for the rest, and *vice versâ*. If the film be detained until *they are set*, the other parts will be dry and insensitive; if they are immersed when the rest of the film is ready, from not being set *they* will be still unset, and being soft the other portions of the film will drag them, and they will be full of *reticulations*, which conditions occurring across features, &c., are very destructive to the picture. In warm weather, especially, the state of the collodion must be carefully watched, and as it thickens by evaporation, *newly washed* ether and alcohol *absolute* must be added, in the proportion of two

Consequences.

Fig. 40.

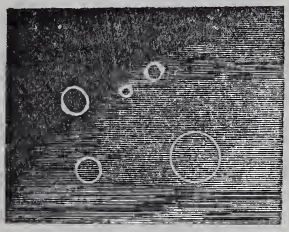


Must be diluted, and how.

parts of the former to one of the latter, until the necessary fluidity is attained. WHITE RINGS.

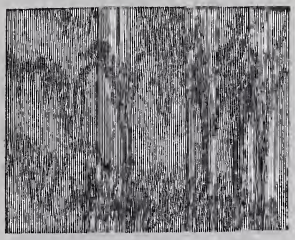
Small white circles, as given in the cut, appear in the subject. This blemish is caused by the operator elevating the mouth of the collodion bottle *too far from the glass* in laying the film; the action established in the liquid, by the minute bubbles created, remains after they may have dispersed, and their traces reappear in the finished work in the manner shown. If care is taken to *depress* the mouth of the bottle sufficiently, before beginning to pour the collodion, these marks will not occur. White rings appear. Not to pour too high.

Fig. 41.



Peculiar *serrated* marks are caused by a greasiness or scum on the surface of the bath, which attaching itself to the film, slides down it when put to drain. This defect disappears after dipping two or three plates, showing that they have exhausted the impurity and cleansed the surface caused by greasy scum. Serrated marks,

Fig. 42.

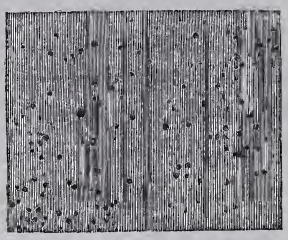


Spots. for succeeding ones. This blemish is entirely consequent on the contact of gutta percha with the bath solution; all other precautions being taken to avoid the presence of organic matter, it is unknown in a glass bath.

Spots of transparency, Spots are of two kinds; those of defective action, leaving bare glass, and printing black, are caused in the following manner.

due to *nitric acid* and Tripoli, Tripoli and *nitric acid,* recommended sometimes for use in cleaning the glasses, adhere most tenaciously to their edges, and if present will, when the plate is dipped in the bath, be dispersed by the solution, though it was intractable to water, and settling on it, *and on succeeding* films, causes spots of bare glass to appear. Prepare them as directed, article "Glasses," and carefully filter the bath. A film that has been kept too long in a *new* bath, or that has been *delayed* before exposed in the camera, will thus become dry, and the collodion being acted upon by the nitrate of silver, numerous minute spots are eaten into its structure.

Fig. 43.



or action of nitrate of silver.

Spots of opacity, The contrary appearance—that is, spots of opacity on the plate, printing white—is produced

by dust settling on the film in certain stages of adhesiveness of the latter, and not forming "Comets," but spots, by minute centres of increased action. By the film being laid from a highly coloured sample of collodion, and excited in an old bath which has become over-iodized; lastly, and most frequently, by too prolonged development of an under-exposed plate, and using excess of drops of bath solution in the developer, the effect of which is to cover the surface with minute specks of concentrated deposit of silver.

COMETS. from dust,

Fig. 44.

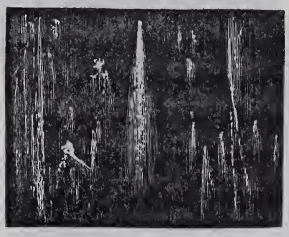
over-iodized bath.

"Drops" in developer.

Photographic "Comets" are defects which bear a remarkable resemblance to the forms of their prototypes; they are caused by particles of dust in the atmosphere of the developing room, which, descending on the wet film, reappear in the picture in the shape of spots, comets, &c., by the action for which they serve as nuclei; when they arise from this source, the tails, &c., stream from them

"Comets," when vertical, caused by dust.

Fig. 45.



Comets. in a *vertical* direction as they lie on the *surface* of the film, and are caused by action in the bath liquid, retained by them, flowing downwards

Remedy. Greater care in *clearing away dust*, &c., will prevent their being seen on the plate. They will

Resulting from collodion. likewise arise from an inferior quality of collodion; from carelessness, with a good sample, in not decanting the *upper part* of it from a large *stock bottle* into a smaller, thus leaving all impurities of former manipulations behind; by using the collodion *immediately* after iodizing; or from not wiping, with sufficient care, the necks of the bottles from dried fragments of collodion or dust, or from any flue, &c., off the glass-cloths, adhering to the surface of the plate. When they are *in* the collodion itself may be known by the tail-like appendages, &c., taking a curved form of direction, consequent upon the rotatory motion imparted to the liquid in laying the film; whereas those dependent on the action of substances merely resting *on the surface* of the film, have direct vertical lines of *drainage* action.

Differ in their form.

Fig. 46.

Lines crossing the plate, Straight lines, of varied intensity, crossing the plate from side to side, are caused by any pause

STAINS.

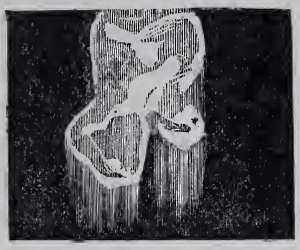
or hesitating movement with which the dipping of the film into the nitrate bath may have been accompanied. As has been mentioned, the action should be firm, prompt, and consecutive.

caused in dipping.

Marks often appear like small beards of light *following the forms* of the high lights of the subject, and streaming downwards from them in the direction in which the film stood when exposed in the camera. This defect is caused by the plate not having been sufficiently drained before exposure; the action is caused thus: The rays of light which delineated the fingers, linen, &c., in the image, were diverged and reflected by the descending liquid, and possessed, in the *immediate vicinity* of the high lights, sufficient power to impress an action. Remedy—to obtain a clearer outline, drain the plate more before putting it into the slide.

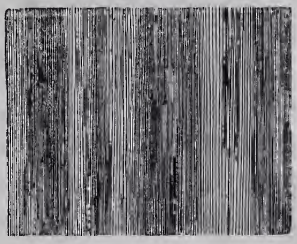
Defective drainage

Fig. 47.



marked in the camera.

Fig. 48.



The marks do not attach themselves to the forms in the picture, but are seen as

In dark room.

STAINS. a parallel streakiness of various intensity and
Streaks, how caused. width across the picture.

These appearances may arise from three causes, and the following tests will enable the operator at once to decide to which he should refer them. The subject was taken in the camera, of "landscape" form, but the marks appear in the contrary sense. The defect was in the dark
Diffused light. room; diffused light, some crevice, or insufficient yellow blindage, were the cause—that is to say, if they are incapable of removal when the film is gently rubbed either with cotton wool or the finger.

Marks similar in appearance to those just described, but appearing in the sense in which the film stood in the nitrate bath are due to
Impurities in bath. alkalinity or nitrites, or some impurities in the nitrate bath, and are often met with in an old bath, in which organic matter in one shape or other is present. They may at once be perfectly distinguished from the preceding defects, which are similar in appearance, by being entirely on the *surface* of the film, and capable of removal by friction.

Another cause for the appearance of such marks is the following. When working with sensitive conditions of chemicals, if with deficient
Deficient illumination quality of light, or *small area of size* in the subject to reflect back the pencils of light to the film, the

operator should use too small a diaphragm in proportion to either; or that the focal length in the camera should be considerable—the *darks* of the picture are not thrown with sufficient *vigour* on the film to guarantee it from the *general* action, which partakes more of the nature of diffused light than of those distinct pencils of light—with intervals of partial or *total privation of it*—which a more complete action would possess; the consequence is, that the lights are not intense, the shadows are weak, and that the *drainings* of the bath liquid in their course down the film *leave traces of their passage*. But if on testing, the defect arise from the causes given above, the whole will be found *in the body of the film*, impressed by the action of light, and not capable of removal by friction, as some parts would be if caused by impurities in the nitrate bath.

STAINS.

its consequences.

Distinct *smears*, with fainter deposit on them, are visible across the subject. They are probably caused by the perspiration on the hands of the assistant who cleaned them, having found its way first to the clothes, and from thence to the surface of the glasses. The only remedy, in warm weather especially, is to have a good relay of white cotton gloves for him to use.

Smears, origin.

Marks at the top and corners of the subject—which in the camera was the bottom—arise either

Marks of drainage,

Stains. from the film having been too little drained, and the accumulation of bath at the bottom during exposure—or from neglect in blotting out the slide between each picture.

Fig. 49.

Both of the above will be aggravated, if, in taking the slide from the camera, it is not carried in the same sense in which it stood, but tilted or *reversed;* or if the flap, after the picture is taken, is too *violently closed,* which has the effect of splashing the liquid collected in the groove upwards over the subject. As with prolonged study, the "collodion back," or holder, becomes sodden with bath solution. Having to work long and much at one time, two or more backs and inner frames will tell in the improved results.

in camera various.

Defective slide. A mark of greater light occurs along the whole of the bottom of the subject.—The light has got in at the *top of the slide* whilst the film was exposed, showing the necessity of keeping it covered with a cloth whilst in the camera. The subject has a vigorous deposit on the lights, but the *shadows* are too much filmed over to be bright and telling. It cannot be over-exposed, or the lights would not be so vigorous, it most probably,

particularly if working with a double lens, arises from diffused light or reflexions. Stains. Diffused light.

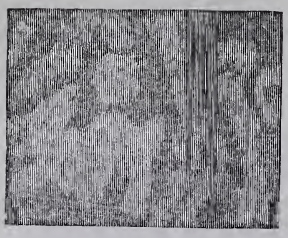
It would, no doubt, be the best practice that the lens and camera should be so enclosed that the lens, through an aperture, should see *only the subject,* thereby avoiding all reflexions from surrounding light objects, and giving the purest definition of which it is capable, but this, in practice, is found troublesome, and loses much time. Reflexions.

A much *larger and deeper brass shade* than is usually sold with each size of lens, lined with *black cotton velvet* (a great absorbent of light) answers every purpose; and has the advantage of allowing the operator much more freedom of action in placing his camera, whilst the shade being *on the lens,* follows its movements; when it may be necessary to shift its position in the field, by altering the sliding fronts. Remedy.

Stains of development are, in the earlier part of the photographer's practice, very annoying; the most frequent are those of *inequality of action,* caused by unskilfulness in not covering *at one sweep* the whole of the plate, or of not keeping the developer in continual motion, and thus allowing its greasy streaks and stains to impress their image on the film. Using the solution of too great strength will mark a sensitive film by its sudden and violent action, and the impossibility Stains of development. Unskilfulness. Over-strong solution.

Stains.

Fig. 50.



of evening it quickly enough; lastly, using too *small a quantity*, in proportion to the superficies of the film, is sure to create stains from its inefficiency to cover the extent of surface.

Blank patches.

Patches of insensitiveness, arise in two ways, but may each be distinctly referred to its origin. The first are caused in the development, by the operator having poured the solution continuously on *one portion of the film*, instead of distributing it all over. The result has been that he has washed away the silver, which should have formed the image, from that part, and a bare patch is seen in the film; but when arising from this cause there is a remedy. Add drops of bath to the developer, and tilting the plate, apply it neatly to the deficient portion, in which the subject will *immediately* appear, and if done skilfully, not allowing the other parts to be strengthened, it will not be perceived in the finished picture,—the same sort of appearance results from keeping the film too long before dipping it in the bath, especially in hot weather; but there is one appearance which at once marks the difference of the cause, namely, that when arising from this source, iridescent

Silver deficient in film.

Remedy.

Or delay in dipping it.

tints accompany the mark, which in the other were not seen, and the application of the nitrate drops, the effect of which was *instant* in the former, is powerless in this; the only remedy is in greater promptness with the next film. Stains. No remedy.

The defect caused by the opposite treatment, namely, dipping the film *too soon,* makes itself visible in *thickened* edges of insensitiveness, called "fringes," on the pouring-off margins of the plate, and a general rottenness and reticulation of the film, which will probably tear up with the action of the water. Reticulations, likewise, are the effects of breathing over the glass, or neglecting precautions in damp weather; *water* is thereby added to the collodion. This is the reason why, in inferior or unskilfully prepared samples of collodion, reticulation is a frequent blemish,—the alcohol and ether contain *water,* and we thus perceive the necessity of the caution given for their preservation, in perfect order, in small bottles. Dipping too soon. Effects of moisture.

Hypo stains are of the most formidable and hopeless description; generally traversing the whole plate from the corner where a *finger or thumb unwashed,* after the development and fixing of the last subject, came in contact with the film. *Continual* use of *clean water* and towel (no soap) is necessary in operating. Hypo stains.

We have thus examined the various causes of failure in the *manipulation* of the collodion pro-

STAINS.

cess, and although many precautions may have been more dwelt upon than their nature would apparently warrant, such minute details are *entirely necessary,* and if the reader will only *strictly adhere to them,* he need never doubt that in taking up a subject he will be secure of an *unblemished negative.*

Minute precautions *ensure* success.

PART IV.

SUBJECTS;

THEIR NATURE AND TREATMENT.

PORTRAITS.

Portraits.

Interest of, and reality.

There is no application of Photography which is more interesting and popular than portraiture; there is likewise none in which many difficult, and sometimes antagonistic conditions, require to be nicely balanced and fulfilled, if a perfect result is to be anticipated. When this has been successfully accomplished, and due artistic feeling infused into the arrangement and position of the sitter, nothing can exceed the interest possessed by a picture which is the *actual reflex* of the person represented.

Dimension important.

Dimension is an important point in photographic portraiture. The exigencies of the lens

PORTRAITS. prevent us attempting many sizes that would be desirable, and the artist who undertakes large portraits has various disadvantages to overcome. The focal length of the lens employed is great, and its action slow, and the sitter's countenance which, had it been taken rapidly, would have been lifelike, sparkling, and intelligent—no matter what his good looks or otherwise—becomes leaden, vapid, and indeed loses its resemblance to the original; for the soft and mobile parts of the face, round the mouth—which is the chief seat of expression—have so drooped that their very form has altered during the sitting. Thus photographs which have been attempted, approaching *life size*, have been most abortive and disagreeable, and heads of three and four inches have not yet been obtained, with the *figure and hands* in the picture in fair focus and drawing, and when the *head alone* has been given, the operator has been obliged, in order to obtain any degree of rapidity, to use too large an aperture, and the *line* of correct focus traversing the face is, on both sides, in immediate contact with distorted forms.

Rapidity.

Consequences of slowness.

Head alone. When it is desired to take heads of *this size* it is useless to attempt the hands and figure, the face must occupy the *central* portion of the lens, and, thus treated, heads of study, &c., can be obtained up to four inches or so.

The *largest size*, at which a portrait can be

undertaken, that shall include the person and hands, is a head about two inches in dimension; and we now attain a size which, although difficult and exacting, permits us more freedom of action in the composition of our picture. Lenses of four and a half, five, and six inches *diameter*, and *focal lengths*, varying from fifteen to twenty-four inches, are required to execute this class of pictures, and the diaphragm must not be more than one half the full diameter if good qualities are desired in the subject, a six-inch lens is quite capable of giving the *full-length* figure and accessories with such a head, but the feet being liable to appear enlarged, *three-quarters* is more recommendable, thus avoiding that disfigurement. Pictures of this size cannot, however, be undertaken in unfavorable light, as it would then be necessary to enlarge the aperture, and the correctness of drawing would suffer. The time of exposure required will be from thirty to fifty seconds. The next dimension is of one inch and a half to the head; this picture can either be obtained by using smaller lenses, or retiring the same ones further from the sitter, the latter mode is the better. At this size the *full-length* portrait can be perfectly accomplished, without distortion of the lower extremities, and *groups* of two or three persons, in the same picture, are capable of being executed. As the increased area of the subject

PORTRAITS.

Head, hands, and person.

Full lengths.

Conditions required.

Exposure necessary.

Portraits.

Groups

Portraits. reflects more light to the lens, more rapidity of action, and intensity become perceptible, and with *groups* of figures surfaces of twenty inches square can be successfully undertaken. For single

Data for dimensions. full-length figures sixteen inches by thirteen, or fourteen inches by twelve; if three-quarters, twelve inches by ten, or ten inches by eight, are suitable dimensions. It will be perceived that the qualities of focus and drawing in the picture have become more perfect, as the size was diminished from the last, and in this dimension we may consider that we have the best average of desirable qualities. As much *importance in size* as can be photographically attained, without sacrificing correct drawing, and from the power of depicting the

Correct representations. whole of the person adding materially to the interest and value of the representation.

As the focal length in the camera will have diminished *with the same lenses* in retrograding from the object, we shall, at this size, gain about

Rapidity increased. a sixth in time of exposure with the same apertures; or if the planes of distances in the subject are not difficult, and we wish more rapid action, the diaphragm may be slightly enlarged, and the exposures to be anticipated in the best conditions of light will be from twenty to thirty seconds.

Smaller sizes. The next gradation is to heads of one inch in size. We now enjoy great latitude in points which in the larger sizes have been difficulties to

contend with; but, on the other hand, we approach dimensions which are deficient in importance, and incompatible with many requirements. The same arrangements of composition can be made, and the appropriate sizes will be ten by eight in full length; eight by six in three quarters; and six by five in half length. We can now reduce the diameter of the lens employed; three inches is the proper size to use to works of this dimension—diaphragm from two inches to one inch and a half—time of exposure eight to ten seconds.

PORTRAITS.

Appropriate dimensions.

Smaller sizes than the last become of the utmost facility; the time of exposure is reduced to a minimum, and the focal depth in the picture is great. They are taken with lenses of two inches in diameter, or with the three-inch combinations removed further off, which, from the greater parallelism of the rays, can be used, if desired, at the full aperture. In the studio small groups can be taken in four or five seconds; and, if in the open air and sunshine, as rapidly as the lens can be exposed and covered. It is desirable, if opportunity offers, that the artist should make two or three essays, at small sizes, of the subjects intended for *larger works*, which will serve as sketches to show the manner that the light and shade, the positions, and the colours introduced, tell *photographically* in the picture.

The smallest sizes, their facility.

Essays or sketches recommended.

PORTRAITS.

Time of exposure;

Exact time of exposure is the next condition to consider after dimension, and the effect which its success or failure has upon the picture in giving delicacy and refinement, or coarseness to the features, is so great, that it cannot be over-estimated. The difference it causes can be seen

its great importance;

on comparing an *under-exposed* work with hard outlines, sooty shadows, and chalky *enlarged* features, without delineation of form, and one which has been successful, in which the features

its effects on the picture.

are rounded into softness by half tones, and the shadows being reflected into, appear silvery, clear, and transparent.

The development of the image requires most careful watching, as if the deposit of silver in the film is too weak, the face and hands of the sitter

If correct may be deteriorated,

will be *dark*, and if the development is carried too far, or drops of bath are added to the solution in order to give solidity and brightness to the high lights, a small excess suffices to render them so opaque that they are deficient in half tones, and that, although the exposure in the camera

in developing.

was correct, the injudicious development has so loaded the lights as to give the effect of an under-exposed picture.

So that we find—besides the condition of our chemicals, and the composition of the picture—in order to produce a perfect portrait, we must not exceed certain limits in dimension, that our

focus must be satisfactory, our exposure absolutely or nearly correct, and our development judicious; and that a failure in *any one* of these requirements, will render the finished work unsuccessful. Before attempting to place a figure for portraiture, the operator should be perfectly acquainted with the qualities of his lens, the *size of picture* which it gives at different distances, *the time*, approximately, that different diameters of aperture demand, the degree of *flatness or curvature* of its field, and the depth of *correct focus* which it is capable of giving in the subject, which preliminary study can be better carried out from a life-sized bust, having the quality of immobility for comparison of successive plates, than from the life.

PORTRAITS. Conditions necessary to success. Preliminary study; its nature.

Having considered all these points we now proceed to take the picture.

The first thing to arrange is the nature and colour of the background, which should be so managed as to produce a *variety* of light and shade, taking care also that it composes properly with the dress of the sitter; that is to say, that a *black coat* or dress, if placed against a *dark ground*, would be lost, and the head, hands, and linen, appear as *spots;* so if a *light or white* dress is depicted against a *similar* tone, insufficient relief and chalky monotony will probably result; nor is it sufficient to relieve dark upon light or

Background arranged. Its qualities.

Portraits. light upon dark, the result of which would be mechanical. There must be a play and *variety of light and shade* in the background which will give artistic qualities, and which, if judiciously managed, will make the interesting points of the figure or costume salient by opposition, and withdraw from the notice of the spectator any which may be disadvantageous. All this can easily be managed by shading parts of the background and

The sitter shaded. of the sitter's costume. There must be a projecting shade of blue calico over the head of the sitter, which serves three advantageous purposes; namely, to afford relief to his eyes, to produce *gradation* of shade on the background, and more especially to prevent light from arriving in a vertical direction on the head and face; which would give a snowy appearance on the hair and too heavy and dark shadows under the features.

Arranging the camera, Before the sitter arrives let the camera be *in situ*, at about the requisite distance for the size intended, and the centre of the lens at the height of his chin, which may have been previously ascertained: if accessories are introduced let them be analogous to his position or vocation, it will be well that they should all be previously placed in desirable focus, and their effect studied in the

and head rest. camera. The head rest for standing figures is the one described (fig. 30), page 77; it must be wedged under the stand to prevent any tremulous

motion. On the sitter's arrival endeavour to put him as much as possible at his ease. Turn the fork of the head rest on one side; let the sitter *stand* upright (be sure he does not lean) against the pad of the back rest, which should touch him firmly, and against which he may turn round, as on a pivot, and change his position till advantageous. This arrangement secures the *hands, figure,* &c., from movement. Now retiring from him, your eyes strictly in the line of the *centre* of the lens, observe the picture—improve, if possible, the position of a hand or the turn of the head—note, that any movement of the sitter's head should be *very gradual,* small alterations making in the camera much difference; avoid all appearance of effort in attitude or expression—quiescence or repose is the best; at all events let both be as natural as possible. Now go to the camera, the lens at full aperture; see, on focusing *just* on his eye, how the arrangement of the subject and figure and *the angle* of the camera agree with the focus of the mass of the picture; the head, of course, should be pretty good; look to the hands, and if one or both of them are in bad focus alter their position: the nearer the picture is made correct at *full aperture* the better. The accessories can, of course, be moved in any direction that will better their focus. When the composition is satisfactory come to the front, place

Studying the composition.

Gradual changes.

Lens at full aperture.

Placing the accessories.

Portraits. the fork of the head rest *gently but exactly* against the head, screw it firmly, being careful that it is in such a position as not to show in the picture. If you have a skilful assistant, capable of pre-

Preparing the film, paring the plate, he should so have timed his arrangements as to be now ready, and on a signal given entering—which will be as well behind a screen, not to disturb the sitter—having previously

and diaphragm. put in such diaphragm as the nature of the subject and the light at the moment will dictate, and covered the lens, he puts the collodion slide in its place, uncovers the film, and remains ready to remove the cap; turning his back to the sitter if seen by him. Now quickly, as the collodion will

Final scrutiny. not wait, give a rapid scrutiny to the drapery and hands, which if well are better not fingered about, as they become mannered and stiff. Do not let the sitter pass his tongue across the lips, as many have a habit of doing at the last moment, the reflexion of light on the *wet* surface gives white not colour (see Light, page 13); it is well

Animation desirable. that his expression should be animated by conversation to the last moment.

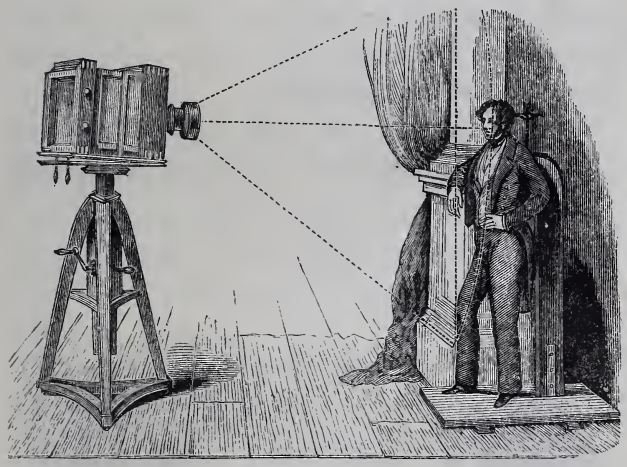
The picture must be commenced with the desired expression; having got which instantly, but gently, uncover the lens. Watch well the quality

The qualities of light. of the light; blue sky, with white cumuli, are what is most desirable; north to west the quarter of the wind; eleven to two the best time of the

day. It is better to turn away from the sitter, as persons looking at him may derange his expression. Portraits.

For such a picture as the foregoing, the *flatter* the field of the lens, the better, as the accompanying illustration will show: Observe on Standing figure.

Fig. 51.



focusing to the eye, the line of principal focus strikes precisely the front of the chest, the head, &c.; had it been more curved, the hands and person would have been *out of focus*, resulting in the distortion and enlargement of those parts. If accessories are introduced on a table, &c., the diaphragm will be exacting; the advantage of this three quarter form of portrait, as against full Flat field of lens desirable.

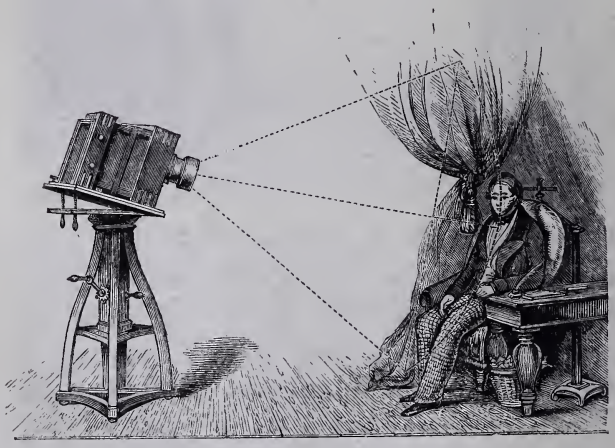
PORTRAITS. Lower parts distorted.

length, in photography, is that the extreme lower part, which being executed by the margin of lens is the weakest in definition, falls on the middle of the sitter's legs, where in the costume of either sex there are no forms to demand careful delineation; indeed, whether the folds of a robe, or the unpicturesque trowsers, it is as well, and throws more interest into the head, that the lower parts should be as it were sketchy; not so if it were a full length, the feet would appear enlarged under such conditions.

Sitting position.

Now, in treating this same class of portrait in a sitting position, two conditions differ, and

Fig. 52.



must be remarked: first, that the camera should be rather higher than it was placed for the

standing figure, and "dipped," whereby it will take a line of focus more accordant with that of the figure, as shown in the cut. And next that to treat seated figures, a lens of which the field is *less flat* is *positively* better, since the curve includes more advantageously the knees and hands, in this position, than the flatter field of the former lens. It has been recommended to put a sheet or white surface on the ground, at the feet of the sitter; a very disagreeable light in the eye is the result, giving a sinister expression to the countenance, besides being very fatiguing to the sight of the sitter. It is much better to work with a *lower angle* of light on his person, and thereby, and by its being sufficiently diffused, render the shadows on the countenance less harsh.

PORTRAITS.

So flat a field not desirable.

Reflectors.

The best light for portraiture, is the quarter of the compass from N.W.—N., to N.E., and *to the eye* the effect of light and shade on the sitter's face should be so gentle that the shadows are hardly defined; the collodion film being very sensitive, appreciates their gradations more readily; if they were seen on the face as they would be desired in the picture, they would appear in the finished work with dark and Carravagio-like effect, ill fitted for portraiture, and only permissible in heads of study.

The most advantageous light.

Appearances described.

TAKING A GROUP OF SEVERAL FIGURES IN THE STUDIO.

GROUPS.

Before attempting this, the most difficult operation in Photography, it is necessary to study several preliminaries. It will be highly desirable that the operator should make a sketch of the proposed composition, always bearing in mind, in so doing, the exigencies of focus. If he be judicious in his arrangements, there is nothing whatever to prevent his having the satisfaction of seeing his conception perfectly realized by the camera, with such delicacy of finish as Nature's handling is alone capable of.

Previous sketch desirable.

His sketch being made, he must now decide at what size it will be judicious to execute it, not forgetting that certain distances in *depth,* from front to back in the subject, will only admit of equivalent limits in the dimensions of the picture; and that by attempting *large sizes,* with *deep* compositions, defective definition will be sure to result. He must remember that focus is the pencil's-point in Photography, and that it will be impossible to make a perfect work if it has been neglected.

Dimension studied.

Having selected such lens as may seem best adapted to the dimensions proposed, of which an

Lens selected.

approximate guide is given at the end of this section, he must fix his camera opposite the place where the subject is to be composed, and at such distance that the area necessary to contain the intended group just fills up the space allotted to it in the camera; he must take care that the camera is at right angles with the subject, and he must now ascertain the line of principal focus at full aperture of his lens, through his picture, taking a point near the centre for the most interesting objects in his composition, as there the correct definition of his lens will be greatest; he will place numerals, as described at page 43, on the curve of the focus, and marking the results on the ground, be enabled at once to place the still-life, background, &c., and to arrange for the figures in the most favorable situations, to comply with those exigencies by which he is restrained; remembering, "Ars est celare artem," and that no traces be observed, in the resulting picture, of his careful management. As he proceeds in the arrangement of the composition, it will be well for him to refer continually to his camera, *at full aperture*, to see how the important parts of his subject stand relatively to the principal focus; noting, however, that the focus will be deepened and the definition improved, when he shall afterwards put in such diaphragm as may be judicious. It will be well that the background

GROUPS.

Preliminaries.

Subject arranged.

Diaphragm.

GROUPS. should be in less perfect focus than the principal objects in the picture, but not too much so. If the persons are at hand, who are to be introduced in the composition, or if there is a lay figure and some of the draperies which are to be used, a trial negative may be taken, which will show

Photographic sketch. if the colours are *photographically* desirable, or the contrary; should either some isolated objects in the picture, or larger masses of the composition, require to be lighter or darker, use may may be made of the following expedients: first,

Expedients to alter parts. for *small portions*. Furs, rocks, stones, hair, hands, or complexions, leaves, grass, earth, carpets, &c., may be lightened as much as necessary by a powder-puff, directly applied, or shaken a yard or so above them, so that an atmosphere of extremely minute white particles shall settle on them—chalk or whiting may be lightly smeared on iron work, carved wood, or other surfaces, &c., or a stiff "hog tool" may be used to those or other surfaces with powdered chalk; larger parts may be tinted wet with whiting and lamp black to any tone required; or to darken take burnt umber and lamp black, and apply dry or wet as directed previously.

To change larger masses. If *large portions* of the composition would be better kept down, a blind or curtain, either opaque or semi-transparent, as thin muslin, may be interposed between such parts and the light, and by

various trials of such effects on different parts of the composition very fine results may be arrived at. Should parts be too obscure, white paper, sheets, or looking-glasses may be used to throw light and reflexions into the picture. The so-called "daylight reflectors" are useful for this purpose. Arrangements must be made to give the sitters support during the sitting, without such necessary aids to their steadiness being apparent, or in any way interfering with the freedom and nature of their positions and expressions; sometimes, if the attitude be not difficult, a very small matter will suffice—anything *rigid* that will prevent the *sway* of the body. Having thus sufficiently prepared the subject, the actual execution of it arrives; here the greatest attention will be required that the draperies take a proper arrangement of folds; that the positions of the bodies, heads and hands, and more than all, that the expressions of the countenances are as they should be, for it suffices that a finger be disagreeably placed to spoil the whole as a perfect work; and this, when several figures have to be treated, apart from all difficulties of manipulation, may well explain how far approaches to anything like satisfactory results are seen in this department of Photography. The size of aperture to be employed with the lens must be regulated by several conditions; the depth of the picture, the quality

Groups.

Daylight reflectors.

Final arrangements.

Precautions.

Groups. of the light, the nature of the positions and expressions are the chief points to consider. The conditions which will demand or admit of a diminished

Diminished aperture. diaphragm are—perfection of light, shallowness from front to back of the subject, and positions of an easy character; as for instance, sitting, well supported, and the eyes not turned fatiguingly to the light; such diameters of aperture will always

Increased, and why. tend to give much greater refinement of definition and beauty to the drawing of the objects represented, but are incompatible with bad or indifferent light, a *deep* composition of picture, and positions or expressions of countenance which the sitters could not maintain without a visible appearance of constraint. All these points having been considered and provided for, it will be better that the sitters should not be retained in their places, until the collodion film is taken from the bath to drain, which will prevent unnecessary and deteriorating fatigue. Of course it is in many

An assistant desirable, respects better that an assistant should prepare the plate, leaving the artist entirely free to arrange the picture; but to show the student that

but can be dispensed with. it is not absolutely necessary, it may be stated that groups of several figures have been arranged, the whole of the manipulations performed on plates of some size, and several negatives, with satisfactory expressions, produced entirely without assistance, within the hour. The great point in

such compositions is to see, before uncovering the lens, that not a hand or drapery is misplaced, leaving the expressions to the very last moment, when they are satisfactory—of which the artist must assure himself very rapidly—gently, but quickly, uncover the lens; it is better to maintain perfect immobility, and on no account to allow any spectators of the operation, who may readily, by their presence alone, spoil all. GROUPS.

It is surprising what a wide scope for the artist exists in this department of Photography; *à priori*, it would be supposed that he would be limited to the mere representation of an angle of a room, with any additions in the shape of furniture, &c., that he could introduce; such, however, is far from being the case, a vast variety of subjects, or portions of subjects, as studies, are within the powers of Photography in this department; indeed, it might be said that almost *any* description of group or composition might be successfully represented by means of a little study and ingenuity. Nature of subjects. Varied and numerous.

Water, rocks, foliage, flowers, plants, fish, game, and any other still-life, analogous to the matter on hand, may be so arranged with the figures that the subsequent observer shall not have an idea that the picture was composed and treated in the studio. By varying the light and shade on portions of the composition by blinds, or moveable

GROUPS. frames of yellow glass, most instructive and interesting results may be obtained, and such varied effects of *chiar-oscuro* on the *same subject* would be most useful as studies and appreciated by all artists.

The proper lenses. These pictures can be treated up to twelve by ten inches, either with the single or double lens; the qualities of the first are larger sizes of the objects rendered at the same diameters and distance from the subject, longer exposures, and less intensity and rotundity in the picture, but the writer would recommend the double combinations in preference, since the foregoing are a class of compositions which must be treated in the glass studio, and consequently out of direct sunshine. The modified light, though sufficient for the action of the double, is slow with the single lens, and beyond a diameter of three inches such lenses become, from their focal length, too slow, and are not proper to attempt.

Some data for lenses. The dimensions of double lenses, relatively to the sizes attempted, are three inch diameter for eight inches by six inches; four and a half, for twelve inches by ten inches; and five, six, and eight, for larger works: the apertures used, and time of exposure, depending upon the qualities desired in the finished picture.

RUSTIC AND PICTURESQUE FIGURES,

Figures. Differ from portraiture.

Whether singly or in groups, differ from portraiture and subjects of refinement in this important particular, that whereas the latter are obliged to be taken in a tempered light, in order that the shadows on the faces may be softened, and the features as delicately rounded as possible; the whole of the subjects comprised in the title Rustic and Picturesque figures, gain in character and vigour by being executed in open sun-light, provided that the shadows are treated with sufficient skill to prevent their degenerating into heavy black masses without reflexion.

Can be taken in open sunlight.

This is photographically advantageous, since the increased power of illumination allows the picture to be taken very rapidly, thereby avoiding the blemishes that it would show in a more prolonged exposure, with sitters often intractable and ignorant. It will be advisable that the operator should give considerable attention to the grouping and arrangement of his materials, so that they may have a *natural* and pleasing effect; the best method for him to accomplish this, is to watch a group when they are not conscious of his observation, and when subsequently setting them,

Attention to selection and arrangement.

The method.

FIGURES. or similar figures, for the camera, to endeavour to reproduce what he has previously noted.

So little has yet been seen in this class of subjects, that it may almost be considered untrodden ground, and a rich harvest of admirable material presents itself to the discriminating operator in every locality. With proper selection, the most interesting and useful studies can be collected, whether by the military and naval services, the tourist and traveller, or the more stationary photographer. It matters not whether the subjects represented be taken from our own fields and shores, or from more distant and, to us, more interesting, localities; the truth and exactness with which they can be rendered by Photography, will insure their being generally appreciated. What is most requisite is, that the figures composing such groups should have an air of natural occupation, as if in their usual vocations or amusements. When, heretofore, they have been attempted by amateurs and others, they have been shown as a stolid half circle of gaping figures, intently staring at the lens. Now it must be evident that such a picture can excite no feeling of satisfaction, even in persons of the most uncultivated tastes in art, who are, however, not slow to appreciate the merits of more tasteful selection and arrangement. It is very desirable, and adds much to the interest and instruction of such

Form desirable studies.

Taken in natural groups.

Not staring at the lens.

Generally instructive and interesting.

pictures, if the dwellings, implements of their calling, the animals they employ, their trappings, and the vehicles of the different countries, are represented in the same studies as the figures. If thus arranged and treated, it matters not whether the harvest-fields or hop-pickings of England, the posadas or sierras of Spain, with their Murillo-like beggars, their trains of dusty mules, and gaitered arrieros, the noisy and many-coloured zoc of Tetuan or Tangiers furnish the subject, or whether the narrow streets, crowded fountains, or rich bazaars of Cairo and Constantinople are realized, or if the mail-clad warriors of Circassia, the tents of the Bedouin, and the endless variety of picturesque costume of the East are represented,—all are interesting, instructive, and highly useful in many directions.

Figures.

Suggestions for photographers.

The lenses employed for these subjects are both the single and the double: the first when larger dimensions are desired, and the operator is *sure of his sitter,* since the time required will be greater; the second—and at large apertures—when many individuals, children, animals, &c., are comprised in the composition, which would necessitate a treatment approaching the instantaneous. Three and five inch lenses, both landscape and double combinations are excellent sizes

Data for the instruments.

Sizes of lenses and pictures.

FIGURES. to use, and with them figures, varying from the smallest dimension in an instantaneous distant group, to single figures of fifteen inches in height, can be obtained.

INSTANTANEOUS PICTURES.

A desirable condition; If there is one direction more than another in which we may look for greater artistic excellence and interest to be imparted to the photographic picture, beside judicious selection and tasteful arrangement, it will be by the process being so much accelerated, by optical and chemical improvements, that any dimension and class of picture may be taken *instantaneously;* nor need we despair of witnessing this result, when we see what progress a few past years have brought with them to this art.

generally applicable, The benefit to be derived from an instantaneous picture, is equally great *for every subject taken from nature by the camera,* with the exception of still-life, and mere geometrical architectural elevations; here, as everything is fixed and stationary, the smallest possible apertures, and longest desired exposures, may be employed; and in this direction we may presume that nothing more is to be expected. But astonishing as the quality of

definition may be that, under such conditions, is obtained; the result is often cold and mechanical, from want of *selection* in the point of view and deficiency in qualities of *composition* of line and light and shade, and therefore not possessing the interest that the smallest subject taken at the hedge-side, or on the sea-beach would have.

INSTANTANEOUS. where most required.

It is by the rendering of the vivid *expressions* of heads taken from the life, of the perspective view in the crowded city, with all its incident of passing and moving life, of sea and river subjects viewed in calm and storm; in the first, the white cumuli piled up, their snowy masses delineated to the depths of the cloud, the idle sails flapping on the masts, the bright reflexions from both on the water, full of drawing and *rippling* in the light breeze; or the sombre rocks, or haven's entry, with the sharp surges dashing on them, the keen wind felt in every form of the moving waves; the fisher-boat's dark hull rising on the crested sea, dashing the white foam from her bows, the straining lines of her sails and gear yielding to the blast. In the landscape, the sky, one of the chief components of its beauty, will not be a white blank, but by its lights and shades will give charm and value to the whole composition, and waving branches and moving leaves will cease to be curious mystifications.

Subjects to be treated.

Marine.

Landscape.

Views in distant and picturesque cities will not

INSTANTANEOUS.

seem plague-stricken, by the deserted aspect of their streets and squares, but will appear alive with the busy throng of their motley populations.

All these subjects and many others will be glorious things to look upon, when they shall be rendered perfectly by Nature's own drawing.

Disadvantages of long exposure.

Shorten the time which the nervous sitter has to remain under the mesmeric influence of a gigantic glass eye, and you will see his contracted and rigid features expand, and a genial light diffuse itself over his face, and life and nature will be worthily represented.

Much of the foregoing is even now in our power to realize, but with our present limited resources we must be modest in the *sizes* we attempt; size alone, in a photograph, when unaccompanied with high qualities of other kinds, only serves to make more visible the falling off from the excellence to which we should have attained.

Moderate sizes with present means.

Large sizes, from the *increased time* required for their production, are obviously a mistake in this class of subjects, which will possess admirable qualities even if of the smallest dimensions. The great Turner's magical and lovely vignettes, which alone would have formed a colossal reputation, were not so large as the palm of the hand.

Favorable conditions.

To take instantaneous pictures, we require first favorable conditions of light, atmosphere and temperature. We must next, by judicious selection,

endeavour to secure equable BALANCE of *light and shade* and of *distance*, if the extremes are too great *in either* failure will probably result. For example, in the first, a chalk cliff in sunshine, with dark rocks in shadow at its base. In the second, objects as foreground taken *too near* the lens, and included in the picture with extreme distances; the result of which would probably be, that at large apertures—which the manipulation necessitates—the two extremes would not come out perfectly; if the development was continued until one part was satisfactory, it would be at the expense of the other.

INSTANTANEOUS.

Unfavorable conditions.

The class of subject the best adapted for this treatment is the marine—in it a more even balance of light and photographic action exists between the sky and the water which, with all its markings, will come out as rapidly as the sky itself. River scenery offers more hinderance than other landscape, as the greens of the foliage, and the blue and grey reflexions of the sky on the surface of the water, have very unequal action; and a development which shall suit both is difficult: avoid taking such subjects looking *towards* the sun, as then the trees will be black masses without any drawing. Animals are very interesting objects for study by this process, and although very successful representations of them have been made, there is still much opportunity for

Desirable subjects.

Suggestions.

INSTANTANEOUS.

developing the capabilities of the art in this direction.

The chemicals.

The operator's first care must be that the chemicals to be employed are in the most perfect condition; the bath used should in cool weather be forty, in warm thirty grain solution. It will be well to have at hand two or three samples of collodion, more or less recently iodized; the developer, newly prepared, is to be used at the full strength of the three grain solution. The lenses proper for the purpose are the double combinations; the three and five-inch diameters give good pictures; the first will cover eight inches by six, the second twelve inches by ten, if they are of good quality, with the three inch a two inch aperture, with the five a four inch aperture, have given pictures, in a London atmosphere, of remarkable qualities. Vehicles and animals in motion, pedestrians, their costume blowing in the wind, have been developed on a foreground in which every pebble was defined with a minuteness the longest exposure could not surpass.

The lenses.

Treatment in developing.

If the picture developes weak and rather fogged, clear it as described, page 109; if weak *but not fogged,* add bath to the developer, or use solution, one grain chloride of gold per ounce, aqua distill., to strengthen the image.

Instantaneous slide.

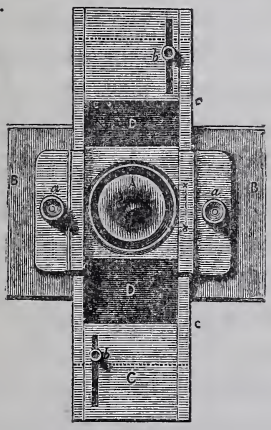
To uncover the lens the contrivance shown in the diagram is recommended, having the advantages

that it leaves the operator at full liberty to watch his subject, and by pulling a string at the moment he judges opportune taking the picture. The *falling* slide can be screwed on at *a a* to the front of any camera, B; the lens operates through the aperture A; the slide, *when drawn up*, covers it with the bottom portion C; now, on relieving a catch it falls by its own gravity—the most even and instantaneous motion possible—and the opening in the centre allows the lens to see the subject for a distance varying from half its diameter to two diameters, according as the two shutters D D may have been adjusted with their respective screws *b b*, this alteration in the aperture regulating the degree of exposure of the subject.

INSTANTANEOUS.

Description of its action.

Fig. 53.



The same result oan be arrived at by the rotation of a disk of thin metal or of wood, centered in a similar manner to the diaphragm plate of micros-

Another method.

INSTANTANEOUS.

copes, with a strong spring of vulcanized Indian-rubber attached; on releasing a catch the rotation of the perforated disk will cause an aperture of greater or less size to pass the lens. This arrangement may be made either in *front*, or within the camera *behind* the combinations.

Before or behind the lens.

The mode of exposing by the cat's-eye principle is faulty, inasmuch as it gives a longer exposure to the *centre* of the lens, thus increasing still more the unequal action already existing between its definition and that of the margin.

Faulty arrangement.

Anticipated advances;

As has been previously mentioned we must anticipate great advances in all directions in Photography, and no doubt the sensitiveness of the chemicals will be much increased; but even with the means *now* at our disposal, *printing negatives* of moderate dimensions can be taken in the fraction of a second, perfectly representing the various objects seen in nature, whether in *motion* or not. It suffices that the operator should give considerable attention to the condition of his bath, &c., to secure a satisfactory result.

possible with present means.

LANDSCAPES.

Beautiful in *details*.

The photographic landscape, judged by the rules of art, is yet far from being a *perfect* work. It presents to the spectator many charming parts, but taken *as a whole* it is defective as a picture.

LANDSCAPES

The sky, that principal point of the landscape painter's selection and care, in the photograph has no existence, but remains a blank. If a river or water in any of its many picturesque combinations of lake, falls, &c., enter into the subject, the treatment of it by *lengthened* exposure in the camera, becomes a photographic conventionality, with certain smudgy reflexions in the one case, and woolly looking white patches in the other; wanting entirely in the *drawing* of the ripple of the near water, the beaming light or passing shadow of mid-distance, or the sharp sparkling dash of the mountain stream. The trees in most instances have waved their branches backwards and forwards during the execution of the picture, and on what should be their delicate and feathered margins, enigmatical forms are found.

Sky and water wanting.

Other drawbacks.

These points render photographic landscape seldom quite perfect as a whole, though exquisite in the detail of its parts; and when by dint of careful selection and study, anything approaching a satisfactory result is attained, it should be valued in proportion to the difficulties overcome.

Successful results.

Generally speaking, the subjects which will offer the best conditions to the camera, are those situate amid *mountainous scenery*, as Tyrol, Norway, Switzerland, Wales, and the Highlands of Scotland, for the reason, that the height of the distances dissimulates the want of sky, and,

Best applications.

LANDSCAPES indeed, as they are full of sufficing forms and drawing, are better left in repose. The masses of rock in the foreground and middle distances are rendered by the camera in a manner which leaves nothing to desire, and the whole being composed of rigid forms, any degree of desired definition may be attempted with probability of perfect success.

Injudicious subjects.

The subjects which are least adapted for the camera, are views on plains, over sands, and generally all subjects of *low horizon*, in which the *sky* or water form a large portion of the picture. When trees are introduced, calm days must be selected, as then there is little or no movement in their branches; or situations chosen—such as glades in woods—where shelter is afforded by the contiguity of masses of foliage. Picturesque "bits" of landscape, with water and other mills, ruins, cottages, &c., selected with care will come well, these objects giving point and incident to the subject; a large field is yet fallow of STUDIES of useful details of foreground, for the treatment of which the camera is eminently qualified, and such subjects will be very useful to art.

Portions as *studies*.

If in photography the entire landscape is to be attempted as a complete work, which shall satisfy the critic, it is to the instantaneous process we must look, if even the result, as regards *size* is limited, as by that treatment alone the combi-

nation of *sky* with hill and dale, and river or lake, will be obtained, and all the captivating effects of passing cloud shadows, and gleams of sunshine on different portions of the landscape represented. These are effects of light that have never yet been photographically rendered, and the difficulties are of course greater from the greens of foliage offering impediments to rapid exposures, but which, however, *at moderate sizes*, are not insurmountable if skilfully treated. LANDSCAPES

Sky, water, and cloud shadows represented.

The student should note distinctly, that however astonishing and captivating extreme definition and detail may be in *studies of foreground*, &c.; in the *general* landscape, fine broad effects of light and shade will supersede it all. Mere clean mechanism on the plate grows monotonous, and will always succumb to the sentiment conveyed to the mind of the spectator by representations—photographically less perfect—in which any of the changing effects of light and shade may have been successfully rendered. The artist should likewise consider that *careful and discriminating selection* will make itself felt in this, as in every other description of subject, and must not go out with his camera as to a sort of photographic battue, in which *one well studied picture* seems not to be the desideratum, but *quantity* not *quality* is sought for.

Effect more than detail.

Tasteful selection necessary.

Now, the truth is, that one little bit of well

LANDSCAPES Application.

selected fore-ground, a bank with a few docks and thistles, with the bright sun-ray glancing from the tufted grass to the gray ivy-grown stump of the gnarled pollard, is worth a hecatomb of such things.

Tents necessary.

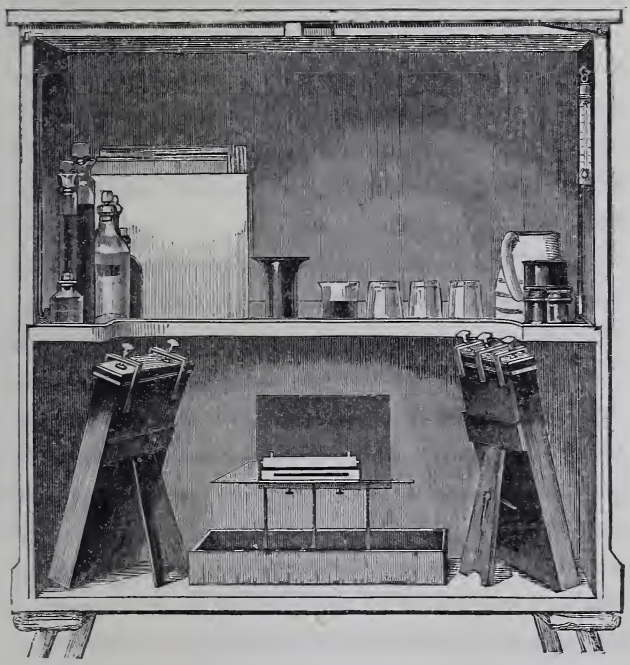
The execution of landscape pictures entails the necessity of having a tent, van, or some other means for the manipulation of them, since none of the "dry processes" are sufficiently sensitive to attack the recalcitrant "greens" of landscape with anything at all approaching the power and sensitiveness of the ordinary wet collodion. Whilst at the same time the operator may, in these railway times, be some two or three hundred miles distant from *the* pet subject of which he fondly imagines he has a transcript, safely in his baggage, but of which illusion subsequent development proves the fallacy; the only certain way is too *see the result* before leaving the spot. The objection to the tent is its want of rigidity, and itself requiring a separate package. The woodcut shows the construction of a *box* which *contains the whole* of the photographer's material of Camera, lenses, baths, &c., and at the same time opens into a *rigid* and sufficing operating space with shelves, sink, and every necessary appliance, and has been in practice found to answer most admirably up to sizes of twelve by ten, which, with the minute qualities of

Disadvantages of *dry* processes.

Travelling box shown.

photographic representation is really large enough for most subjects. LANDSCAPES

Fig. 54.



The lenses proper to employ for landscape pictures are both single and double; the first to be used when the subject is of that nature that some size is required, and that it will not suffer by a lengthened exposure; the best diameters are two and a half, three and a half, and five inches, covering respectively eight inches by six, twelve inches by ten, and sixteen inches by twelve; the

Appropriate lenses,

Sizes of pictures.

LANDSCAPES

aperture to be used will be better *small* if the subject is well illuminated, since under that condition the extreme planes of distance will be more perfectly rendered. The double lenses employed should be three and five or six inch diameters, and they will give pictures of very various qualities according to the diaphragms used.

Action of diaphragm.

When extremely minute detail of foreground is desired they should be "stopped down" to an aperture of one inch, and for *this purpose* the diaphragm is better placed before the front lens, which it shelters from the action of diffused light,

Danger of fogging.

as if placed *between*, unless great precautions are taken, a fogged picture will probably result. The difference of quality between the two in such a subject is, that the double combination has *realised* all the forms in a more clear and vigorous manner, and given much more definition than the

Distance and foreground.

single. At large apertures the difficulty is to bring the two extremes of the picture into harmony; but many depths in masses of foliage, which were bare glass and quite intractable to the single lens, even with prolonged exposures, are worked into and filled with half-seen forms by the double combinations. Many very charming effects of aerial perspective, marking the different planes of distance, in undulating or mountainous country, are

Working towards the sun.

obtained by working *towards the sun*—this must be done when it is not *too near* the horizon, as

then the light would look directly *into* the lens. Such treatment of the subject requires precaution to avoid fogging; it is well to shield the lens, whether single or double, by a dark cloth, which can be held above it. LANDSCAPES

If the student has no previous knowledge of *artistic* treatment of landscape, he should make himself familiar with the works of Claude, Turner, Ruysdael, Hobbima, Both, and our own great living talents in this department; as has been previously said, mere skilful mechanism will not suffice; if Photography is to take stand as *an art* those who practise it must qualify by study for artistic requirements. A short time will suffice for an intelligent mind to imbue itself with as much knowledge of the subject as will prevent egregious blunders; careful practice from nature will do the rest. Precautions, Cultivation of taste most necessary.

ARCHITECTURE.

Of all the subjects offered to the camera, none are so facile of execution as those from architectural originals; their rigid and immoveable forms, the large area of the surfaces reflecting light to the lens, in open air and sunshine, present advantageous conditions, which enable *larger* sizes to be covered, smaller apertures to be employed, and longer exposures to be given, than any other class of objects. Facilities of execution.

ARCHITECTURE.

It may, indeed, be said, with considerable confidence, that in the close imitation of the originals, a limit has in this direction been attained, which it will be difficult if not impossible to surpass.

Mechanical excellence.

At the same time that we feel that the mechanical excellence shown in these subjects has been such as to delight by its clear definition and precision, regret has been experienced by artists and amateurs at the mere "geometrical elevation" effect which has characterised some of the best subjects hitherto executed, and which has rendered them much more fitted as *documents* for the office of the architect, than complete and agreeable as *pictures* to the lover of art.

wanting in artistic qualities.

In looking at a series of architectural photographs of the foregoing description, it is impossible not to wish for the completion of the *subject* by the selection of a more picturesque point of sight, the infusion of more artistic qualities into its composition, and its completion, as a whole, by the representation of that foreground and accessories which in nature made it captivating by contrast, and formed a base from which the edifices represented rose.

Size alone not sufficient.

The *mere size* of some of the large subjects of architecture, does not compensate to the artist for the loss of those incidents of composition, and qualities of light and shade, he would have

preferred seeing in the picture, and which at *less dimension*, were quite within the scope and province of the lens. ARCHITECTURE.

If very large sizes are undertaken, they are of necessity from *plane* or nearly plane surfaces, the wondrous manner in which the lens draws every minute break, angle, or varying surface in the perspective view is not seen, and though our first impression is surprise at the *dimension* attained, our subsequent feeling is indifference to the subject, which, by its mechanical treatment, ceases to interest as soon as its mere novelty has subsided. Lose their interest.

Medium sizes, therefore, are desirable, which shall enable the photographer to produce *pictures* having the composition of line, and qualities of light and shade we are accustomed to admire in the works of the painters who have treated this class of subject. The photograph possessing in addition, the interest given by its being the actual reflex of most interesting localities, and the gratification imparted by the delicacy and minuteness of its execution. Qualities desirable.

The mediæval remains of our own country, historically so interesting to us, the florid Gothic edifices of Spain, her mauresque architecture, the intricacy of whose details bewilders the eye of the draughtsman, the cinque-cento arabesques of Italy, sculptured in marble with an artistic grace and Applications

ARCHITECTURE.

finesse which defy the pencil, all can, with the utmost facility, be rendered by the camera. We have, indeed, had evidence of what it is capable of producing in the Egyptian pictures lately executed, and we must hope that *well directed* study on the part both of professors and amateurs, will give us further interesting and useful subjects.

to subjects.

Facilities for study.

However, in whatever manner they may be treated, it is certain that the facilities for near comparison and study given by photographic transcripts from remarkable architectural examples, will produce as striking results, by the advancement of taste and knowledge, in this, as in any of the applications of the art.

Single lens.

In the earlier practice of photography, the *single* lens alone was employed to execute this class of subject; latterly, some of the most perfect representations of edifices have been made by using the *double* lens, at very small apertures; there is much more rotundity and realisation of the forms of the subject in the latter mode of treatment. The size of lenses employed, if double combinations, is considerable when *large* pictures are desired, six and eight inch diameters were used for some of the elevations of portions of the Louvre. The single lens giving a much larger picture, at the same diameters, has the advantage of greater portability for the amateur,

Double lenses.

Data for sizes.

who would find an eight-inch double lens a cumbrous companion. ARCHITECTURE.

When the operator desires to produce a minute representation of a flank of an edifice, as a geometrical elevation, the mode of proceeding is as follows. If windows in buildings immediately opposite permit, endeavour that the lens shall be placed at about one third the height of the subject, instead of on the ground, whereby the proportions will be better observed in the picture. Carefully *level* the camera with the spirit-level, to preserve the lines in the perpendicular, and use the *smallest diaphragm* the nature of the light will allow. These pictures will be perfectly calculated for the use of architects, as if skilfully taken they may be considered as *exactly drawn to scale*. Geometrical elevations. Mode of treatment.

If it is desired to produce works of a more artistic character, in which various masses of buildings, at different planes of distance, are introduced, *less dimensions* must be attempted; in some such subjects, as for instance, views of Florence looking down the Arno, of Paris from the Seine, &c.; the want of figures in the picture is not so much felt as when the squares and streets of populous cities are represented; here, if anything approaching the appearance of the originals is to be shown, it can only be by combining in the picture the moving panorama, and Picturesque combinations. Complete pictures,

ARCHITECTURE. not giving a Pompeian aspect to the most crowded and busy thoroughfares. For the first, single or stopped down double lenses may be employed indifferently; the resulting pictures will be distinguished by the less size, and greater definition in those taken with double lenses; for the second double lenses can alone be used. The operator must avoid *large masses* of shadow, and if skill is shown, pictures of twelve by ten inches may be thus obtained, not but that very considerable difficulties must be contended with and overcome; but if *a picture* is to be presented to the spectator, of this class of subjects, which shall impress him with the aspect of the original, as seen in nature, it is to this treatment alone we must look for success.

difficult of treatment,

but possible.

MARINE SUBJECTS

Different classes May be separated into two classes, *afloat* and *ashore;* it is needless to observe that the only treatment to be adopted with the first is the *instantaneous;* and these subjects, even with the means the optician and chemist have already placed at our disposal, are quite possible, and only want proper artistic *selection,* and sufficient photographic *skill* to reward the operator by most interesting pictures.

instantaneous,

MARINE SUBJECTS.

The same caution which has been elsewhere given must here be repeated, not to attempt *too large* dimensions, twelve by ten, or ten by eight, amply suffice; and it is much better that at those sizes a picture should be produced possessing any perfect qualities of *daylight*, atmosphere, &c., than by attempting sizes that are not within the power of our present resources, to hear the pictures qualified, as that clever "*moonlight*," as one of the best examples of this application of photography, habitually is by the general public.

at moderate dimensions,

Marine subjects *on shore* may be treated by longer exposures, and with either the single or double lens, they comprise fishing cobles and other small craft, capstans, buoys, anchors, and all sorts of picturesque fishing and sailing gear, lying on the rocky or sandy beach; and, combined with them, it is quite within the scope and province of such a photographic subject that groups of analogous figures, which are always at hand, should be introduced; observing only the caution given in another place, and make the picture if possible, tell a story, or at least let its figures have their occupation and attentions *within it*, and not directed to the camera.

by longer exposures;

their nature.

Suggestions.

ANIMALS.

ANIMALS. A class of subjects which has been little treated by photographers, and which yields to none in interest, are animals from the life. They of course present insurmountable difficulties for any mode of treatment which implies a lengthened time of exposure, but most exquisite things, of a limited size it is true, are quite within the power of the operator; and by taking them in full sunlight, with rather large apertures of a double lens, pictures may be obtained which possess high qualities of artistic interest.

Rapid execution necessary.

Artistic interest.

It is well, in treating them, that an arrangement should be made, whereby the operator and his apparatus are entirely hidden from the animals, as otherwise, his advance to the camera, the act of uncapping the lens, his every movement, will cause the ears, eyes, and heads, at the least, to be defective in the picture.

Desirable precautions

This is very easily managed, by a canvas screen of small size, supported at each end on sticks, with pegs and strings to give it firmness, and an aperture in the centre only large enough for the lens to pass through. It will, in most cases, be much better if a contrivance for uncovering the film to the action of light is made *inside* the

camera, behind the lens, as thus all movements that would disturb the animals are entirely avoided. If the lens has a projecting shade over it, the chance of fogged pictures from the action of reflexion on its large uncovered surface will be diminished; whilst at the same time—as it will be more concealed—horses and shy animals taken at near distances, will be less alarmed by its brightness. It is likewise an excellent expedient to place small branches of foliage, trusses of hay, or any familiar objects which may happen to be at hand, against the canvas. A black curtain, excellent for many other purposes, may do duty on this occasion for the screen; the dark colour, so far from being objectionable, is better than a lighter for several reasons.

against fogging

and movements of the animals

The same result may be arrived at by taking them actually from the photographic carriage, which in some cases, as deer, &c., will be found convenient, as they may be followed. Remark only, that just before taking the picture it will be necessary, by the insertion of wedges of wood, to neutralize the action of the springs of the carriage, or the image will suffer; also that the aperture for taking the picture should, by its distance from the ground, correspond to the average height of the human eye, otherwise the picture will appear unnatural; as if it is taken from too high a point of view, the animals will seem to be *looked down*

taken from a carriage.

ANIMALS. upon. The arrangements for bath, collodion, developer, &c., must be precisely similar as for instantaneous pictures.

PATHOLOGY AND CHIRURGERY.

PATHOLOGY. Photography has not yet been so generally applied to depict the phases of disease, and delineations of morbid structure, as it doubtless will be. The nature of the medical student's education eminently fits him skilfully to utilise its powers in various directions connected with his study, and the few applications that have been seen by the public—amongst others, the characteristics of mania, in its different stages, by Dr. Diamond—show the assistance that it will be able to render to science in this department. Doubtless before long it will be rare to find a public institution in which the most instructive cases are not daily noted in their progress by Photographic means. For this portion of its application "quick-acting" double lenses will be required, since the nature of the light used would be exacting; *short focused* three and four and a half inch diameters would, even in such localities, give pictures in a few seconds.

Powers of delineations.

Skilful manipulation.

Pathological application.

Studies of the osseous structure may be treated at considerable sizes by the single lens, and the

Studies of morbid structures.

delineation of the niceties of form is most remarkable; it is only necessary to have seen photographs of portions of crania to feel what its powers of realization are. Pathology.

"Preparations" offer more or less difficulty to Photographic representation; if, from their nature, they are intractable to the action, *double* lenses, at small apertures, with long exposures, should be employed, and a *direct vertical* light avoided. Various treatments.

STATUES, BUSTS, BASSI RELIEVI, AND BRONZES.

The above objects are amongst those which offer few difficulties to the Photographer—neat and careful manipulation will enable him to produce with much certainty good pictures, for the size of aperture and time of exposure is of no consequence, whilst, at the same time, if the manner in which they are lighted and reflected be well arranged and the background judicious; delineated by means of Photography they will have a beauty of drawing and rotundity which can be attained in no other manner. Statues, &c. Facilities offered. Perfection of representation.

To the tyro in the art, desirous of applying himself to portraiture, some preliminary practice from busts is most desirable, as by such study he desirable for study.

Statues, &c. will gain the power of comparing, with the *greatest exactitude*, what the effect of certain apertures of his lens, distance from the object, time of exposure under different conditions of light, have in rendering the result more or less perfect.

Proper treatment. The best treatment to adopt for works in marble is, that they should be executed with a *double lens*, in moderate light; thus more rotundity is obtained, and the transitions are not too violent, as they would be liable to become—

How lighted. especially if modern works, in pure white marble, were treated in too violent light. Startling effects of sunshine are not for this class of representation; they detract from the delicate modelling of the *forms* of the originals, which should be the principal object to attain, and in such pictures a *flatness* in appearance of the statues or busts is observed.

Antiques, The great works of antiquity offer, unfortunately, two great obstacles to their being rendered photographically, which, could it be perfectly accomplished, would be most interesting to the world of art. They are for the most part in

obstacles to their delineation; situations in which the want of light prevents a successful result, and from which their great value and weight prevents their being temporarily removed. Added to which, the fractures and yellow

stains on them; earthy stains existing on most of them, make themselves disagreeably conspicuous; and though

there is a remedy for this in the *very lightest* possible wash of whiting or plaster and water, skilfully applied, it is more than doubtful if, in the majority of cases, its application could be permitted. Thus we shall probably not see satisfactory representations of the Apollo, Laocoon, Venus, &c., unless they should, under very exceptional circumstances of removal for the restoration of the respective galleries, be secured by the local photographers. STATUES, &c. remedy.

Such originals are not capable of being represented at *very* large sizes, for their excellence consisting in the perfection of *form*, any distortion would render the picture worthless: one foot is about the extreme height that the Venus de Medicis could be well rendered, with a six-inch double lens, stopped down to an inch aperture, which would imply excellent condition of light, when a group, as the Toro Farnese (the original of which is in a good light), or the Laocoon, has considerable *depth* in its composition, their greater dimensions will be photographically neutralized by that condition, and the size limited accordingly. The writer found, in copying the Theseus and Ilyssus from the original marbles, that though they were of heroic size, and offered considerable facilities of lines, it was not possible to exceed one foot in dimension. Busts may be attempted to three and four inches for the head if skilfully treated. Sizes possible. Data for dimension. Elgin Marbles.

STATUES, &c. When subjects of this class are executed with the single lens a flatness and want of intensity result.

Single lens inefficient.

In modern works of pure *white* marble, care must be taken to *modify the light* by blinds, otherwise the gradations of half tones, a principal quality in such subjects, would be lost in flat white masses void of drawing.

Bassi Relievi facile.

Bassi Relievi offer much less difficulty to a perfect result, from the shallowness of their depth for focus, and if judiciously lighted the appearance of *reality* with which they can be rendered will find admirers who cannot appreciate their other qualities; indeed, the imitation of a fracture or of the granular surface of the time-worn marble, seems often to fix the attention more than the general forms of a masterpiece of antiquity; but in copying such works the business of the photographer is to omit no precaution which shall secure the representation of the outlines *of the whole* in great perfection, and not *force* attention to qualities which are in common with a piece of ordinary masonry.

Common-place qualities to be avoided.

Bronzes: their nature.

Bronzes will require much more light than marbles, the eruga on antiques will produce a more vigorous action than its appearance to the eye denotes, consequent upon the *blue* colour present in it: those of the cinque-cento period, that have an even black *dusty* character, present greater

facilities; abstain from touching them as every *finger mark* will appear on the photograph. STATUES, &c.

The most usual failure in representations of bronzes is the direct opposite of that which takes place with marbles; in the one case flat *white* surfaces appear void of drawing; in the photographs from bronzes *black* patches, without forms delineated on the proofs from bare glass on the negative are more usual—this must be guarded against by a considerable reflexion of light from *white*—not polished—surfaces, on the shadow side of the bronzes, and by sufficient illumination and exposure. Failures the opposite to marbles. Remedies.

STILL-LIFE.

Pictures from objects which come under the above denomination, are admirably calculated for representation by the camera, and have besides the great advantage of making the student perfectly acquainted with the peculiar qualities possessed by various textures, surfaces, and colours, and the treatment which each necessitates to arrive at a satisfactory result. STILL-LIFE. Desirable for representations. and study.

The most difficult objects to delineate are all bright and polished *surfaces,* which reflect white light (see p. 12), as armour, fish, &c. The most advantageous, are those whose *textures* offer great Bright surfaces.

Still-Life. opportunities for exact imitation, such as animals and birds, carved wood, mattings, &c. In making these studies, it will continually be experienced that objects which are of the *darkest* local colour, will come out light, provided that the structure of their surfaces is such as to present portions to advantageous reflexion of light; thus *smooth* black morocco-leather tells as a *dark*, whilst the corrugated comes out *light*. This is a main feature in the action of light on all objects, and governs their appearance in the photographic picture so completely, that the student will find the greatest assistance in his subsequent compositions, from the knowledge he will acquire in arranging and photographing groups of still-life. Whilst, at the same time, such subjects can be made extremely interesting and picturesque, and, from the imitative power of the lens, will always be looked upon with interest, more or less according as the taste of the composition and grouping is artistic and pleasing by *contrast* of *textures*, judicious *composition* of lines, and agreeable *light and shade*.

Varied textures.

Reflexion of light.

Excellent practice.

Desirable qualities.

These subjects may be indifferently treated with the double and single lens, and with both in a full sunlight, or in shade; and on these points much experience and knowledge will be acquired by such practice. Small apertures are desirable, since with them the imitation is more complete.

Lenses, light, and apertures.

COPYING PICTURES, DRAWINGS, PRINTS, &c.

Copying.

Although all objects of still-life present fewer difficulties, artistic and mechanical, than figures, landscape, &c.; taking a really good copy from an oil picture is amongst the most difficult of this class of manipulations, from several causes.

Oil paintings difficult.

The effect of the colours, as seen in the picture, may probably be transposed in the photograph, and thus a light yellow drapery in the high light of the composition, and a deep blue in the dark portion will, in the photographic copy, produce precisely opposite effects from those which they did in the original. If a highly impastoed picture, the accidental thicknesses of the colours, drag of the brush, &c., show more conspicuously as *textures* in the copy, than even the gradations of light and shade of the painting, whilst inequalities of surface in panels, will attract more attention than the subject itself. Lastly, pictures by the old masters, or those more recent, when covered with yellow varnish, will refuse to "come out" with any degree of spirit and brilliancy, but remain clouded, obscure, and muddy. The varnished surface is so much exposed to receive reflexions, from any surrounding objects, that, if great care be not taken to guard against them,

Colours transposed.

Surfaces exaggerated.

Yellow varnish.

Reflexions.

COPYING. the subject, in such parts, becomes obliterated in a sheen of light.

Good qualities. Still, when really successful, a good photographic transcript from a picture has the greatest interest, as being the actual touch of the painter "in little."

Double lens; The double combination lens is far preferable to copy oil-paintings, as it will translate the various tones better, give superior definition, and has a power of greater penetration into all deep

its power in definition; glazings, obscure parts, and difficult colours of the original than the single lens. A *long-focused* lens is the proper instrument; it has the advantages of giving a larger size, has a flatter field, and—on *one line of focus*, which is shallow,—its definition

superior to single. is very superior. These qualities enable it to be used at a larger aperture than a short-focused lens of the same diameter, and render it particularly adapted for this purpose. With a five

Diameter of aperture. inch diameter of lens, and one inch aperture, twenty by fourteen inch size may be readily obtained.

Quality of light. The light, if out of sunshine, must be very good in order that the most obscure parts of the subject may be perfectly illuminated. Pictures are better copied in the open air, sheltered from the wind, and firmly attached, to prevent vibration.

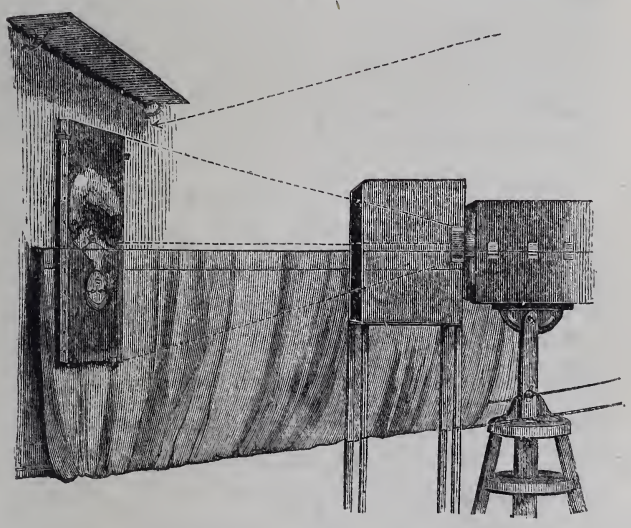
Precautions The greatest care must be taken to prevent the *direct vertical* action of light by projecting a blind *above* the picture, for *one foot* or so, other-

wise the inequalities before mentioned will be very apparent. *Reflexions* from the ground and surrounding objects must be shut out, for which purpose an excellent plan is, that from the lens to the picture, both underneath and at the sides, black *unglazed* calico, cloth, or cotton velvet, should be extended over cords, so as entirely to mask all other surfaces.

Copying.

against reflexions.

Fig. 55.



The time of exposure given should be considerable, therefore extra precautions will be required against fogging. Large sized pictures present the greatest facilities, the extent of their surfaces radiating more light to the lens, and the reduction

Large pictures.

Copying. which takes place giving better qualities of definition; but from highly finished works of *small dimension,* very exquisite copies have been recently exhibited which prove the capabilities of photography in this direction. The collodion employed should be in medium condition, not so sensitive as that required for photography from the life, which under the lengthened exposure would be sure to fog, nor in the highly coloured state which is better for copying prints; as it would then neglect the difficult and obscure radiations. For those who copy pictures professionally a lens specially constructed of the quality before mentioned is very desirable.

Small dimensions.

Quality of collodion.

Chalk drawings and prints. Prints and drawings in chalks are amongst the easiest class of objects to copy photographically, unless the *texture* or *colour* of the paper should offer impediments, there are not many points to consider.

Requisite arrangements. The print or drawing must be placed *exactly square* with the lens, that the copy may be free from distortion. The collodion to be employed is such as would be of a bad quality for portraiture, and for this particular purpose has the advantage of preserving the *chalk granulations* and thin *lines* in etchings, &c., *bare glass,* and giving a *vigorous deposit* on the *blank* portions; a highly coloured collodion will answer best, the double lens stopped down to the *smallest aperture* that will give a picture will be the condition requisite,

as *extreme* definition is indispensible, and if the original is on *white* paper half an inch to a four and a half inch lens will, *in good light*, give a fine result. The point to aim at is that the *lines* and markings shall be as clear as possible, *black* lines must be *bare glass;* the treatment given in page 109, line 6 *et sequitur*, gives excellent results if skilfully managed, in developing this class of subjects.

Copying.

Distinct image.

Copies from mezzotints require such a quality of collodion as would be used for portraiture, their flat and tender half tones requiring more discrimination than other engravings. Water colour drawings are not easy to copy, the colours sometimes interfering, as blue skies, yellow and red dresses, &c., and if executed on very coarse paper the grain shows disagreeably, but they are infinitely more susceptible of a successful result than oil pictures. As large white surfaces occur in these subjects, the film must be laid very flatly, free from waviness, reticulations and all blemishes, which would show more on a blank white portion than in a subject. Should the amateur, desiring to make a copy from an engraving, not be in possession of large sizes of double lenses, it will be better to place the print in direct sunshine, and use the smallest diaphragm possible with the respective size of single lens; very good copies may be taken thus, but they will not equal those by a *long focus* double lens.

Mezzotints.

Water colour drawings.

Lenses and diaphragms.

FAC SIMILES OF MANUSCRIPTS, EARLY PRINTED BOOKS, &c.

FAC-SIMILES.

Difficulties.

Some of the above offer considerable difficulties to photographic representation, the most intractable being those on vellum, the surface of which offers fewer facilities to the reflexion of light than paper, as is perfectly shown by the examination of both under the microscope.

The *yellow* tinge, given by age and discoloration, of very early examples, are the great hindrances to successful representation, but much may be accomplished by the skilful use of the *double lens stopped down,* lengthened exposures and abundant illumination.

Mode of treatment.

This is a very valuable application of the art, as by its means amateurs may from distant libraries produce *fac similes* of unique manuscripts, and portions of rare books.

Valuable application.

STEREOSCOPIC PICTURES.

Stereoscopics.

The appearance of actual relief imparted to the photographic image by simultaneously viewing two pictures taken from different points of sight, is so familiar, that we will pass at once to the description of the *modes of treatment* varying with different requirements; presuming that every one must be sufficiently acquainted with the finished results, and the manner in which the pictures are inspected.

Different modes of treatment.

Theories on the angle.

The vexed question of this manipulation is the exact distance which should separate the two lenses in taking the picture, and a vast amount of discussion has taken place on this point. Now the real fact is, that like many other matters connected with Photography, there is a limit at which scientific theorem must give place to artistic judgment and practice, if the result is to be a *picture* on the qualities of which, as satisfying the cultivated eye, the propriety or otherwise of the whole arrangement depends; and if that is disagreeable or inefficient, all the abstract disquisitions possible on this or the other angle will not make it pleasing or correct. For our guidance in the mean time, there is one very simple general rule, which is, that the *nearer* the

Practical results.

General rules.

STEREOSCOPICS.

Short distances.

lenses are placed to the objects to be taken, the *less distance* they should be separated from each other; that is to say, at ten feet from the subject three inches apart would be ample to give a natural and at the same time striking relief. The consequences of giving more, say six or eight inches, would be—first, that it would only be after a considerable interval, and with pain to the eyes of the beholder, that the two pictures would combine at all; and, secondly, when they had combined, all the projecting portions of the subject would be in the most exaggerated relief; the nose of the sitter of portentous length; if sitting, his femur of Brobdignagdian proportion; the arm of the chair some ten feet long, for the accommodation of an equally preposterous human limb, &c. Now this is an error which operators have often committed, probably to astonish the ignorant by an appearance of extravagant relief.

Exaggerated angles.

Angle varies considerably,

The fact is, that according to the class of objects to be treated, the mode of representing them must be varied; for if such an angle as three inches were applied to a view in nature, the extreme distance being mountains, some ten miles or more from the cameras, the picture would be *flat*, owing to the *insufficient angle* given. For such subjects fifty feet apart is not too much, provided always that the *foreground objects* are not *near* the lenses, as then they would of course

suffer much distortion. Such would be the two extremes—one the nearest approach to an object, the other the furthest removed. All intermediate distances must be managed accordingly, remembering only that in treating a subject a certain *balance of distance* from the camera should be sought for in the picture, which will make the action of the lenses as homogeneous on the near as on the more distant objects, and that when, as in views in cities, &c., the photographer, from the restricted nature of the locality, cannot retire his cameras as far from the foreground objects as he would wish, it is much safer to give too little than too much angle; since in the one case there will only result a certain flatness in the extremely distant objects, those of the middle distance and foreground being well represented; whereas, if in such subjects *too much angle* is given, the distortion of the foreground will be so great as entirely to interfere with the success of the picture.

STEREOSCOPICS.

with subject,

and locality.

There are several ways of taking stereoscopic pictures, each of which offers certain advantages, and some are more particularly adapted to the objects proposed to be represented.

Various manipulations.

First, then, for pictures *from the life,* or of an instantaneous nature: these will require *two* lenses, which must be *simultaneously* exposed and covered, in order that *expressions* and *effects* may

Simultaneous pictures.

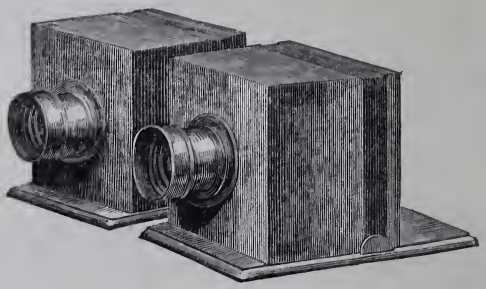
Stereoscopics.

be identical in both pictures. They may be mounted in *one* camera, in which case the degree of angle is limited, but the advantage is obtained

One camera.

of operating on *one glass plate*, and thus securing precisely the same development, &c., in both pictures, and affording greater facility of manipulation to the amateur. Or they may be mounted

Fig. 56.



Two cameras.

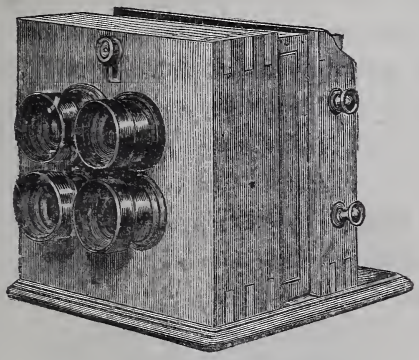
in two small cameras, the difference being that, for distant objects, the angle may be increased at which the picture is taken, but *separate* plates are required.

Elaborate subjects,

When expensive arrangements and troublesome compositions of several figures are undertaken, it becomes very desirable that the operator should, at one exposure, secure more than a pair of negatives; in which case, instead of two lenses, four can be used *in each* of two larger cameras, the

distance from centre to centre of the lenses, vertically and horizontally, being three inches and a

Fig. 57.



half; thus at each time of arranging the group *four pairs* of negatives will be obtained. It is better to allow a margin for thickened fringes, stains, &c., and take them on glasses eight inches square; the additional security amply repays the extra expense.

four pairs at once.

Precautions.

With the first mode, *two* lenses in *one* camera, one glass plate and bath suffices. When the *small* plates are used in different cameras they may be also excited in *one* bath by using a glass dipper of four inches in breadth, which will take both side by side. But in this case the operator must, particularly in hot weather, be rapid, or the first covered glass, having to wait for the other,

Treatment in exciting.

STEREOSCOPICS.

becomes insensitive. The writer prefers *two* baths, and if the plate *first* dipped is the *first* put into its slide the time becomes about the same for both.

Two baths preferable.

Double combination lenses are proper for this purpose, the diameters an inch and a half and an inch and three quarters; they should be ordered without rack and pinion, which are useless and add to the expense, the movement on the bodies of the cameras sufficing. For landscape many operators use the single lens, but the double, *stopped down*, gives much better stereoscopic qualities in some subjects, both of landscape and views in cities.

Data for lenses.

When, instead of *groups* of figures, heads of some size (about an inch) are intended, it is more desirable to employ two *three inch* lenses than to *force* the one and half stereoscopic ones by approaching too near the sitter with them, which is sure to give distortion and weak qualities.

Larger heads.

Subjects treated by more lengthened exposures can be manipulated in a variety of ways, *one lens* and camera—with a sliding back—will give a pair of negatives side by side at any angle which the operator considers judicious. If a near one, from still life, &c., Latimer Clark's arrangement of sliding laths is excellent, but at *considerable angles* this is useless. Have *two* boards, each with "dowels," corresponding to holes, in the bottom of the camera, screw each board firmly on

Lengthened exposures.

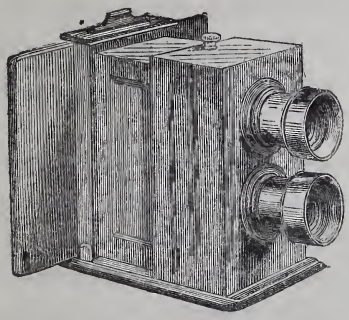
two camera stands—*which are necessary*—focus the subject correctly from *both;* having taken the picture from one, cover the lens, shift the back, place the camera on the other board, and take the other picture. The writer has even used this from the life; three to five seconds will put the camera again to work at the second picture. A better arrangement with such subjects is that the camera should have *two* lenses, one over the other,

STEREOSCOPICS.

One camera, *two* stands.

Modus operandi.

Fig. 58.



the advantage being that a *square* plate of two pairs is obtained on the same glass. As has been said, the operator *can,* if quick in his movements, apply this to the life, but for those subjects the *simultaneous* action is decidedly preferable. The ground glass should be *centred* with diagonal pencil lines opposite each lens, and when focusing

Four subjects on one plate.

STEREOSCOPICS.

observe that the subject occupies the same position in each compartment.

Form for groups.

The compositions of groups must necessarily be of an *upright* shape to meet the requirements of the stereoscopic form of picture; the artist should endeavour to arrange the subject so as to take the greatest advantage possible of *varying planes of distance,* which will increase the illusion in the picture; consequently it is desirable to diminish aperture as much as can judiciously be accomplished according to light, &c., in order that the greatest possible perfection of focus may be obtained on the different objects; moreover, the *image itself* is more rotund and stereoscopic taken at *small* than at *larger apertures.* (See page 29.)

Planes of distances.

Small apertures desirable.

Manipulation described.

The manipulation with *two* plates requires some little practice, in order that both may be treated *identically,* and with the requisite celerity; the mode of proceeding is as follows.

Both the glasses should be perfectly ready, lay the film on the first, put it in the bath and cover it; proceed the same with the second; after the proper delay, taking the first from the bath, drain it, and put it in the slide, *stand it vertically;* treat the second in the same manner, and at once expose both. "Caps" must on no account be attempted with so many lenses, or even with more than *one;* a double black cloth, *carefully*

Mode of uncovering.

managed—to prevent the access of diffused light —answers very well. STEREOSCOPICS.

Returning to the operating room, manipulate the film first excited, before the other; *develope* *smartly* as the size is small, and time is valuable, wash the plate well, and put it down. Proceed with the second, and endeavour to make both of an equal strength; should the second be slightly insensitive, drops of bath in the developer will raise it to the power of the first; wash well, and proceed to fix both in hypo. Mode of developing, and fixing.

INTERIORS OF EDIFICES, &c.

The most necessary conditions to success in these subjects are the quality of illumination which they possess; and the power, by their dimensions, of sufficiently withdrawing the camera to prevent distortion in the nearer portion of the picture. Necessary conditions.

It is by no means *absolutely* necessary that the subjects should be lighted from the top, although when that condition is found in picture and sculpture galleries, &c., it is *more* advantageous; windows, of some size, in the sides of apartments, churches, galleries, halls, &c., perfectly suffice. One desirable condition is *space to retire the* top and side lighted.

INTERIORS. *camera*. In cathedrals, with stained glass windows, or a very dark local colour in the stone, success will be doubtful, the operator will find the greatest possible difference in the action in those parts of the building opposite the direct influence of the sun and those in a contrary extreme.

Cathedrals.

Lenses proper.

Double lenses are alone to be used for such subjects, three inch *short focused* lenses with two inch aperture, will give pictures in twenty seconds to three minutes, according to peculiarities of light, &c., in the subject; when the size of the building and conditions of light permit, pictures with excellent qualities can be obtained up to twelve inches square. The writer photographed the sculpture galleries in the British Museum—some side-lighted—on twelve by ten inch plates, in two and a half to three minutes, with a four and a half double Ross. In Westminster Abbey, the light being unfavourable it was more difficult to obtain good results, five to ten minutes exposure was required by some objects in north aspects, whilst with those facing the south one minute sufficed.

Dimension of pictures.

Data for exposure.

Lenses and collodion.

The collodion and the bath should be as for portraiture, the lenses three inch, six inch focus—three inch, ten inch focus—four and a half inch, fifteen inch focus—will give pictures in the ratio of size of *one, one and a half,* and *two*. Thus—six inches, nine inches, and one foot; with corresponding facilities of all kinds to the *smaller* dimensions.

ASTRONOMICAL PHOTOGRAPHY.

Astronomy.

A great deal of special study and treatment, and the use of large and perfect astronomical instruments, is required when photographic representations of the moon, planets, stars, &c., are attempted, and success will only be the result of patient and untiring perseverance through discouraging failures.

Lunar and stellar.

Prolonged exposures.

The time of exposure must be prolonged, and the motion of the earth carefully neutralized by appropriate mechanism skilfully applied.

Solar, its difficulties.

The difficulties of solar representations lie in another direction; the *heat* at the precise *focus,* and overpowering *intensity* of the light, are the conditions to be antagonized, which may be accomplished by *sifting* the light through a bath of alum and distilled water, enclosed between *parallel* surfaces of glass, which will stop the *heating principle,* and various tones of grey and green glasses will obstruct *so much* of the superabundant *light* as may enable the operator to obtain a satisfactory image by the most *instantaneous* exposure.

Means of obviating.

The best instrument to use for this purpose is a *single* lens of very *long focus,* which need not be of large diameter; if mounted in a tube, and

Astronomy. passed through an orifice, the image can be focused on an opaque surface, in a darkened room, and the tube being "capped" from the lower end; on the film being placed in position, it can be exposed with much facility.

Exposure *instantaneous.*

An image is thus procurable with good qualities of one inch or more in diameter, and capable of enlargement.

MICROSCOPIC SUBJECTS.

Microscopics. The application of photography to the delineation of microscopical representations of objects does not offer so many difficulties as astronomical subjects; very satisfactory pictures were produced some years since, and more recently several operators, who have given their attention to microphotography, have exhibited interesting and instructive specimens of its powers.

Present few difficulties.

Objects mounted transparently The class of objects treated have always been those mounted transparently; amongst those which have given the most successful images are Acari, the tracheæ, spiracles, probosci, and other portions of insects; blood-disks, sections of teeth, bone, and woods, snow-crystals, the appearances produced by polarized light; and recently some very successful pictures were exhibited, by a French operator, of Naviculæ and Diatomaceæ,

Their nature described.

with remarkable qualities of definition and separation of the markings, considering the size at which they had been attempted. MICROSCOPICS.

The only portion of *the microscope* that it is necessary to use, is the *object glass,* which is better screwed into a camera front having a flange adapted to it, than retained in the microscope body; thus avoiding, by the increased distance of the lateral surfaces, the chances of reflexions. So that any photographer desirous of giving his attention to microscopic pictures only requires to purchase one or two object glasses, according to the class of subjects he is about to delineate. Object glass of the microscope. Mode of using it.

The object glass of the microscope is of course not corrected for chemical action; but this is of no moment, since, after the second picture, any operator with a moderate degree of skill will be able to fix the point of maximum actinism in which the film should be placed. The difficulties of defective definition increase as the *higher magnifying* powers are used; nor can it be otherwise, since when these very powers are used *optically* the "fine adjustment" screw of the microscope is required to be kept moving, in order that the LINE of perfect focus may pass seriatim over the forms inspected. Now, as the photographic picture must be *simultaneous* in its action, it is evident that *perfect* delineations of the *entire* object can only be obtained by the use of mode- Foci non-coincident. Qualities of "*high powers.*"

MICROSCOPICS.

rate sizes, one inch, and half inch, are desirable for the most general and useful representations.

Size of camera.

The length of the camera body requires to be about two feet.

Nature of light.

The nature of light used may be varied; the *direct* sun-ray received upon *clean* ground glass or on a *bluey white* (not yellowy) tissue paper, is the most desirable illumination. Camphine, and the Oxy-hydrogen, light have been employed by very successful manipulators in this department, in the absence of sunlight. The time necessary to produce the image varies considerably, according to the nature of light used, those from artificial sources requiring much the longest exposures; but the first trial will make a skilful photographer master of this portion of the requirements of the lens. It is better to use the direct sun rays modified, as above mentioned, than to work by *diffused* day-

Exposure.

light, since the chemical and visual foci are subject to more frequent derangement, by *dispersion* of light from clouds, &c., in the latter case.

PART V.

PRINTING PROCESSES.

Printing.

In order that the print resulting from the previous labours of the photographer may be satisfactory it is necessary that his care and attention should still be maintained and extended to the *printing* from the negative, since if it is carelessly or unskilfully executed not only is the permanence of the resulting print, or positive, jeopardized, but its *very appearance* is most inferior, and *totally different* to what it would have been had proper skill and pains been bestowed on its production, so much so, that it might be difficult for a bystander to believe that two pictures, differing so completely in their quality, could have been produced from the same negative.

Great care required.

Results of negligence.

This is unfortunate, since the consequence is that the photograph cannot be distributed to the public at those moderate prices which would pro-

Photographs cannot be low in price.

Printing. duce a *very general* circulation, and that too often from neglect or the *parsimonious* use of expensive chemicals the photograph is deficient in permanence, and a general hesitation and doubts of its powers of duration is created.

The impression of the writer is that if all the printing processes are properly and carefully conducted the photograph, with moderate precautions against atmospheric influences, is entirely capable of perfect preservation.

Quality of permanence.

PAPER.

The paper which the writer has found to possess the best qualities is that marked "Canson Frères," its soft and porous texture seems favorable to the preliminary preparations, whilst in the toning processes the desirable cool colours are obtained with greater facility on its *starch*-prepared surface than on those of the papers sized with gelatine.

Cansons.

Desirable qualities.

It is well to give some attention to selection in the purchase of it, as the large demand seems to have had the effect of rendering the samples very unequal in quality. Great *evenness* of texture, when held up to the light, and absence of small holes, and of iron spots (arising from the trituration of buttons, rings, &c., in its manufacture) are what it is principally desirable to observe.

Selection.

Points to observe.

ALBUMENIZED PAPER.

PRINTING.

The advantages to be derived from the use of paper prepared in this manner are three. First, it has been shown by experiment, that with the *same* printing solutions, proofs on albumenized paper are more *permanent;* secondly, they are more *intense* and transparent in the shadows of the picture; and lastly, they possess more delicate *definition* than prints from the same negative on plain salted paper.

Advantageous qualities.

To PREPARE THE ALBUMEN.—The degree of gloss to be imparted to the surface of the paper depends mainly on the quantity of water used with the albumen; the less is employed, even to the quantity only absolutely necessary to liquidize the salt, the higher the glaze which will result on the paper. For such, this formula will be proper:

Mode of preparing.

Whites of eggs	100
Saturated solution of common salt in *distilled* water	10 fluid oz.
Acetic acid	100 minims.

Recipe for albumen.

This will give a very glossy surface, desirable for stereoscopic subjects, and those with much nicety of detail; the acetic acid tends to preserve the colour of the whites in the prints, and likewise to prevent the albumen from turning yellow

PRINTING. with time. If it is desired to reduce the strength of the solution, to the same quantities add ten ounces, or if more still, twenty ounces, of distilled water.

Precautions. The manner in which the eggs are treated is as follows: break them *one by one* into *a tea-cup*, retaining the yelk *entire* in the half shell, by doing so an accident of contaminating the whole quantity with a broken yelk is avoided. As good a vessel as may be for the purpose is a Wedgewood foot-bath; put the ingredients into it, take a *wooden whisk* (sold by brush-makers), well rinced and dried, and beat up the whole, for an hour or so, until it is a stiff froth, which should rise to the height of the vessel; cover it carefully over, and in about twelve hours decant off the upper clear parts from the dregs; it may, at any subsequent time, when turbid, be passed through a fine muslin folded double—which, however, must have first been rinced in common, afterwards in distilled, water. It is in better order for use after it has been prepared a week or two, and has become acid, than at first.

Better when not freshly prepared.

The paper must be examined sheet by sheet, held *sideways* to the light, and the wrong side—distinguished by the square wire mark—placed *uppermost*. The manipulation requires care and some skill; *no good result* will be obtained if the temperature is low; it should be 70° to 80°, *certainly not less than* 65°,—beginners should not attempt large surfaces at first.

Requisite temperature.

Pour out, an hour or so before using, an inch deep of the albumen into a Wedgewood dish, remove any scum, &c., with *clean* blotting paper, and cover it over from dust—take the paper by the two *diagonal* corners, bring the hands together, and place it on the albumen, which should strike a line across between the other corners; now, with a slightly jogging motion, lower it, until it floats flatly and without any air-bubbles,—let it remain *precisely two minutes,* take it up by one corner, *gradually,*—hold it a minute to drain, and pin it by two corners on a clean clothes-horse to dry. Printing. Manipulation.

When dry, it will be stiffly curled up. The best way to flatten it is to iron with a *cool* iron, between sheets of *clean* blotting-paper. It will require care in keeping, in a *dry place,* the salt it contains having a tendency to attract moisture. With this precaution, it will keep as long a time as desired.

Apart from unskilful manipulation, attempting this process in winter, or with a low temperature, causes most of the failures by streaks, &c., as then the albumen will not flow; even the opening of a door, and allowing entrance to a draught of cold air, will *immediately* show its deteriorating effects. If well manipulated, the surface should be as even and glossy as a piece of satin. Blemishes.

Albumen.—This substance is contained in the blood; the whites of eggs consist entirely of it, and from the latter the photographer obtains the Its nature.

PRINTING. supply necessary. Natural albumen exposed to heat solidifies or coagulates.

Uses in photography. It is used in several ways in photography; as a film, alone, or in combination with collodion, to receive the iodide of silver, and in the printing process it is spread out on the surface of the paper, by masking the irregularities of which, it presents more facility to delicate definition, whilst at the same time, by defending the proofs from the action of the atmosphere, it contributes largely to their permanence.

Beneficial, and how.

PLAIN SALTED PAPER.

Should the photographer wish proofs for colouring, or to see the different effects produced in certain subjects by printing them on "plain salted" paper, the manner of preparing it is as follows:—The right side of paper to be carefully selected as before; a solution to be prepared of—

Its mode of preparation.

Muriate of ammonia . .	20 grains.
Distilled water . . .	1 ounce.

Let this solution stand about one inch deep in a *Wedgewood* tray, and float the paper upon it precisely as directed for albumenizing, observing equal precautions to prevent air-bubbles, which would be blank spots on the finished proof. It may remain three or four minutes on the solution, and then be pinned up to dry.

Avoiding *air-bubbles*.

TO EXCITE THE PAPERS.

If thick papers are used to print the proofs upon, the photographer must be careful that the exciting solution is of eighty grains of nitrate of silver to the ounce of distilled water; otherwise the prints will be weak in the depths. With the usual Canson positive paper, sixty grains suffice; but the paper is better floated for five minutes than for a shorter period, and the solution must be kept up to the original strength.

PRINTING.

Strength of solution.

Time of floating.

The exciting solution should be kept in a dark place; and when much discoloured, it may be cleared by shaking it up with kaolin, which is kept by the vendors of photographic apparatus. The student is cautioned against the use of animal charcoal, sometimes recommended for this purpose, as it communicates a solvent quality to the nitrate solution, which dissolves the greater part of the albumen from the surface of the prepared paper, thus totally unfitting it for use. A *slight* degree of discolouration is of no consequence, as the fixing hypo. sol. subsequently removes it entirely.

Kept in the dark.

Purified kaolin.

Result of using animal charcoal.

A glass tray or dish is the *only* proper vessel for this solution, which should be three quarters of

Vessel proper.

Printing. an inch deep in it. The papers are to be *floated* as before directed, and with the same precautions

Manipulation. against bubbles. The sheets should be removed with horn tongs kept *specially* and apart for the purpose. They should be held *over the dish* for near a minute to drain; as, if *immediately* pinned up to dry, a long streak of stain will drain from

Precautions. the pin, its brass having been acted upon by the abundant moisture.

Care must be taken that no streams or drops of solution get on the wrong side of the paper, in preparing it; as they will cause stains of increased

Mode of keeping. action in the finished proof. As soon as dried, the excited papers should be put away from atmospheric influences in a close drawer; and the sooner they are used the more silvery the tone of colour obtained will be.

TO PRINT FROM THE NEGATIVE.

State of negative, The negative having been carefully varnished, and some twelve hours allowed to elapse, in order that any thickened fringes may be quite hardened, the next process is to print it. The excited paper will require strictly keeping from light and air, especially in hot weather, when even a few hours suffice to decompose its surface; therefore, when the best results are desired, it is indeed

better that the paper should be excited only when going to be immediately used, dried before a moderate fire, printed at once, and toned as soon as possible afterwards. The photograph will have infinitely purer whites, more brilliant darks, and is less liable to part with, or alter, its half tints, in the process of toning. PRINTING. and paper.

The printing presses, or pressure frames, are made of various patterns. See that no particles of grit or dust remain on the glass, nor on the back of the negative, and place the latter in the frame, the subject side towards the paper; remark that it has no flue, &c., upon its surface, place the excited paper evenly upon it, put in the blotting papers, flannels, or felt—whichever it may be furnished with—and the back, and screw gently and evenly down. Precautions with the printing frame

Now, according to the *quality* of negative which is being printed, the *manner* in which it should be printed, to secure the best result, depends—if the negative is slightly under-exposed, whereby the darks are a trifle more bare than they should be, and the deposit on the high lights more opaque than could be desired, printing in the *sunlight*, at a right angle to the position of the sun, will be the best; for the reason, that the action being more penetrating than printing in the shade, the direct sunray will, in a greater degree, strike through the opacity of the deposit on the high and negative. *Varied* treatment necessary,

PRINTING. according to their *quality*.

lights, and tend to give drawing in them, and half tones; whilst, at the same time—the action being very rapid—the extreme darks will *yield* a little in the toning process, and not being so black as if printed more slowly, a more agreeable balance will be established in the picture. A negative of this description is capable of giving thirty proofs in a summer's day, and is the most rapid printer that we know. The *print* is not the most perfect, its faults are that there is a certain harshness and crudity in it; the high lights and darks are in too violent opposition, and are wanting in breadth of effect and atmosphere.

Slightly *under*-exposed.

Perfect.

The next, and the most perfect negative, is more transparent in the high lights of the flesh, and even white linen, when viewed by transmitted light, is not an *opaque* mass, but has markings and drawing all over it, whilst the gradations of tone from white to black, are beautifully depicted, and full of charm; extreme blacks, not being fogged, but still drawn into a little by forms and reflexions,—such a negative would suffer considerably by being sun-printed; the effect would be to give it a general muddy appearance, because the delicate tones and high lights, although quite sufficient for judicious treatment, would be struck through too violently, have lost rotundity, sharpness, and brilliancy, and the darks not having had time *gradually* to take their best vigour,

Injured by sun-printing.

would be vapid and weak; whilst the intermediate tones would have lost their correctness of gradation, and have been much deteriorated. This class of negative should be printed in the shade, lying flat, upturned to the sky; it is not nearly so rapid as the former, six or eight proofs per diem being all that can be had from it in fine printing weather. PRINTING.

The next sort of negative is that which is *fogged,* not by having been exposed accidentally to diffused daylight in manipulating, but by *over-exposure* in the camera; we must make this distinction, because, in the first case, the fogging is merely a veil drawn over a very weak image, and contains *no drawing in itself;* whereas, in the second, the film, although thickened, and rendered thereby very obtuse to light—consequently long to print—contains *the drawing of the subject* of which it is the reflex, and on sufficient printing, its forms will appear, and it will have some good qualities, although it can never have equally correct gradations of tone, nor be so bright and perfect as the last mentioned. Over-exposed. Subject exists in the film.

Such negatives are well printed in the sun, remarking only that, as they will require much time to print them, the prolonged exposure to its direct action on a summer's day will be apt to generate so much heat between the glasses that the varnish of the negative may adhere to the Danger of prolonged sun-printing.

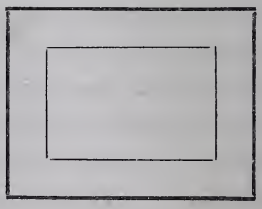
PRINTING.

paper, and, on the removal of the latter, the subject be injured; to avoid which, in this class of negatives, it is well to remove them occasionally into the shade for an interval to cool. Such a negative is the slowest to print—one or two in the day being about the limit in fine weather.

Mode of printing a defective.

We have now treated of the three classes of negatives which, with slight modifications, represent those which are capable of being printed from, without any touching or "doctoring," and which consequently are the only ones which any operator who values his art will tolerate; still it may happen, that, from defective conditions of light, &c., a subject rare or valuable in itself may not have been so well obtained as could have been wished; and in order to enable the operator, without *touching* upon them, which *cannot be allowed under any circumstances,* to draw out the forms which exist in the film, without abolishing, from over-printing, those which have been too legibly impressed, the following expedient is given :—

Fig. 59.



Moderating the light on parts.

Having perfectly cleaned the glasses as directed, place the negative in the centre of the press; take thick mounting-board, and, cutting it by measurement thus, the out-

side edge fitting the press, the inside the negative that is being printed, the effect will be to keep the latter always in one place—having done this, take a proof of the subject. We will suppose a portrait in which the hands, face, and white linen are too opaque compared with the dress. Now, if printed in the ordinary way, one of two things must occur: either those parts must be white if the dark dress is right; or the latter must become an uninteresting black mass, if the former are sufficiently printed up. Yet, observe the drawing *exists* in the film; we only interpose a blind to *retard the action* of the light, and in no way attempt abortive touchings on the subject. Take this proof, paste it on a sheet of thick mill-board, cut out the white parts, and take care that the outside fits to the sinking of the *front* of the press, and corresponds exactly with the parts of the subject desired to be advanced; only *rather smaller all round,* as the light spreads under the thickness of the two glasses.

PRINTING.

Method described.

The subject must be *strictly printed in the shade.* Now, by exercising some judgment, the white parts are allowed to print in advance of the rest as much as is necessary—say one-third or one-half the time necessary for the completion of the subject; then removing the blind, let all go on together. The subsequent printing will entirely

Must be shade printed.

Toning. obliterate any edge that may have formed; and being open, will have more spirit in the darks than a blind of waxed paper cut through in parts and fixed to the back of the negative, as is sometimes practised. The result, of course, is not to be compared to a *perfect* photograph, such as should be the sole aim of the operator: still, *not being touched* upon, it may sometimes be had recourse to, in order to save a valuable subject. In all these printings, the depth of tone to look for must be considerably more than is desirable in the finished proof; whites must be half tints, and the sitter must appear a mulatto at least, leaving it to the toning process to reduce these excesses of colour to their proper limits. As the proofs are taken out of the press, put them quickly away until they are toned, which is well executed as soon as possible. A large book of *clean* blotting-paper is good for this purpose, as it preserves them more securely.

Better than paper screens.

Appearances to look for.

Precautions until fixed.

TONING THE PROOFS.

Toning. Should it not be convenient to tone the prints immediately on removing them from the presses, as before mentioned, great care must be taken to keep them from the influences of light and atmosphere; the more so if in a hot climate, or during

warm weather. Indeed, in either of these extremes, it will be found more satisfactory to tone and fix the proofs immediately. If this precaution is not taken, a deterioration in the colour of the white portions will infallibly ensue; instead of a pure, silvery quality, they will acquire more or less of a disagreeable foxy hue. Having poured out the three solutions, and added to the toning one the quantity of chloride of gold described in "TONING BATH"—strictly in the manner there stated, and having stirred and mixed the solution with a glass rod, take one of the prints by two of its corners, quickly lay it face downwards in the bath, gently press it under the liquid with the horn tongs; now draw it through the solution, and laying it face upwards, examine it minutely, to be secure that it is free from air-bubbles, and that the whole of its surface is wetted; turn it face down again: proceed with the next; and so on.

TONING.

Better toned immediately.

Mode of manipulating.

If good prints are desired, avoid having too many of them toning at once. If they are crowded, or the quantity of liquid is scanty, some are sure to suffer by inequality of tone. They must be constantly kept in motion, the more so, even to continuous manipulation, the better the result. Not only do they thereby avoid reddened patches of unequal action, but they tone quicker, part less with their colour in the lighter shades the half-tints, and have more brilliancy and intensity in the

Few toned at once.

TONING.

Frequent examination.

darks. Do not fail to look frequently at the advancing tone of colour they are acquiring in the bath, which will be much more rapid as the temperature is higher, and slower when it is low. Before they are *quite* as cool in tone as desired, remove them to the *second* hyposulphite or clearing-bath. After they have been in that for five minutes or so, hold them up to drain off superfluous moisture, and pass them at once to the *fixing* bath, in which they may remain from five to ten minutes, according to temperature. Upon the employment of a perfectly *clean solution of hypo* for fixing the proofs, their *stability*, and much of the *beauty of their appearance*, depends. As its action continues, it will be observed that the light portions, which were yellow in colour, will, as the components of the toning-bath are removed from the texture of the paper, become pure and white; and on the perfect removal from the paper of those metallic and chemical combinations, *soluble*, and capable of entire removal *by the clean hypo*, but which, if left unremoved by it, the *mere water* in the next process would have been inefficient to touch, the stability of the finished photograph depends, the proof of which is easy, by washing a print direct from the toning-bath and marking the result. The *pure hypo is soluble* in water; and, though penetrating in its nature, can be entirely removed, by judicious washing, from the paper.

Fixing baths.

Necessity of a pure hypo bath.

Removes the chemicals from the paper;

and is *itself* soluble in water.

Toning.

The infinitesimal division of the metallic particles in the toning-bath is great, their nature and action subtle, and as yet very imperfectly ascertained. The operator will do well to avoid dipping the fingers into this solution, and to avoid contact by the use of the horn tongs, as the neglect of this precaution may have unpleasant results. The prints are now to be withdrawn and immediately put into clear cold water, the *softer* the quality the better. Too much attention cannot be given to the complete manner in which they are turned, and the waters changed continually, *especially at first*. It will be evident that if they are allowed at the commencement to remain in a shallow tray, with a small quantity of water, they would in reality only be in a weak solution of hypo, which would be acting upon and deteriorating them. The changing of the water, if a running stream—which is infinitely better—cannot be procured, must take place in *large earthenware* or gutta percha vessels, at something like the following intervals:

Care in washing.

¼ hour; ½ hour; 1 hour; 2 hours; 4 hours; 8 hours; 12 hours.

Approximate intervals.

Thus changing them, as will be observed, the more often as they have more recently left the hypo solution. At the end of this time, remove them from the water; drain each for a few seconds; then *blot them off between sheets of clean blotting-paper;* and either suspend them to thin cords to

FIXING.

Modes of drying.

dry—for which purpose the wooden "American clips" are useful,— or lay them on a sheet. When dry, either pass a *cool* iron over the backs to flatten them; or, better, put them for a night in a press. They are now ready for the mounter.

NOTE, that more than twenty-four hours in water is entirely useless, and even detrimental to the prints, provided that they have been *well changed*. A continuance of long periods in water, is sufficient *of itself* to produce *visibly* deteriorating effects: also, that any attempt to wash them in painted or japanned vessels, or those made of lead, zinc, or other metals, will result in the immediate destruction of the proofs.

Destructive vessels.

PART VI.

SOLUTIONS AND CHEMICALS.

THE NITRATE BATH.

Importance to the manipulation.

The most important of all the solutions to the photographer, is undoubtedly the Nitrate Bath. Its contamination by contact with any organic substances, or by neglect of any kind, is so fatal to success, that the merest tyro in the art soon becomes imbued with profound respect for his bath. But as the reader may not be aware of the precautions which have been found in practice to be necessary to its preservation in the best working order, the following remarks are offered:—

Various formulæ.

Several formulæ have been given by various writers for the preparation of the Nitrate Bath, some of which are simply an iodized solution of thirty grains of crystals of nitrate of silver to the ounce of water, whilst others are of a more complex character, and various other ingredients are

NITRATE BATH.

used in their preparation. The writer has made trial of several, but has not found in them that *stability* in a satisfactory condition that the more simple preparation gives. They are very excellent in their first results, but rapidly deteriorate by use, even when carefully treated and kept strictly from light; and he has therefore discontinued the use of all but the one of which the formula is given in this section.

The one recommended.

Quantity necessary.

In preparing the solution, the operator must be guided, as to the quantity necessary, by the sizes that he is likely to execute. If they are at all large, considerable waste of the solution will ensue and have to be provided for; and it is not judicious merely to have at hand the quantity necessary to fill the bath in ordinary use; it being better to have *twice* that quantity prepared.

Quality of chemicals.

The chemicals which enter into the composition of the Nitrate Bath should be of the most *undoubted purity*, which is best attained by purchasing them *only* from vendors of character and respectability, who making it especially their concern to procure them for photographic uses, will, by testing and otherwise, insure their quality.

Bottles, &c., cleansed.

In preparing the solution, if the bottles to be used are *new*, they must be cleaned by having a weak solution of nitric acid and water shaken in them, and afterwards *well rinced*—first, in common, secondly, in distilled water. The measures,

funnels, spoons, and glass rods must be scrupulously clean, and none of them must have been used with solutions of hyposulphite; indeed merely putting a stopper down on a table on which hypo had been spilled, and returning it to a bottle would suffice to spoil a bath. The above method of cleansing *new* bottles applies equally to *new* glass baths. NITRATE BATH.

We now proceed (in a *yellow light*) to prepare the solution. The formula is that originally published by Mr. Thomas; and the writer has found it to be the one which gives baths of the most even and *enduring* qualities. Mode of preparation,

It is to be made in the following proportions:— Into a stoppered bottle put

Nitrate of silver . . .	1 ounce.
Distilled water . . .	2 ounces.

Dissolve.

Into a glass measure put

Iodide of potassium . . .	4 grains.
Distilled water . . .	1 drachm.

When dissolved, pour it into the bottle. The precipitate of iodide of silver forms in curdy flakes, which, on well shaking, are entirely dissolved. Now add fourteen ounces of distilled water, when the excess of iodide of silver is again thrown down, but in such a finely divided state as to render the saturation of the bath with iodide of silver

NITRATE BATH.

perfect. Allow it to stand half an hour or so; carefully filter; it should then be as bright as distilled water. *Afterwards,* add

Alcohol	2 drachms.
Sulphuric ether . . .	1 drachm.

NOTE, that the bottle in which it is prepared should be larger by one-third than required for the solution, in order to give room for shaking it well.

and preservation.

When prepared, it will be best preserved for use in stoppered bottles, with brown paper pasted over them; which has the double advantage of keeping out light and giving the operator firmer hand-hold with large sizes.

The solution should be carefully kept from *extremes of temperature.* It is better, thermometer below 40° or above 60° Fahr., to return the solution into an inside cellar immediately after study.

The solution should be scrupulously kept from the action of white light, a mere *passing gleam* of which suffices to set up an action which will be progressively deteriorating.

Testing the solution.

Before operating, the bath must always be tested for its condition (see page 120), which should, for the life, &c., be *just* acid. It is well to have *more than one* bath in use, at different points of acidity; by using various states of collo-

dion in which, the photographer can obtain in the picture any qualities he may desire. Nitrate Bath.

If operators will use gutta-percha baths, they must when new be filled with a strong solution of common soda, which should remain several days in them, afterwards rinced, and a solution of nitric acid and water, which should equally remain some time, then common water, well changed and rinced with distilled before putting the bath into them. With all this precaution, if the solution is *left* in them it *will deteriorate;* the only way is to remove to glass bottles *immediately* after study, *rince* out the gutta-percha with distilled water, and *cover* it from the action of atmospheric impurities. Gutta percha vessels. If used, necessary precautions.

The writer has just taken pictures with portions of the *same* bath, which has been left for six months in two baths, one of solid glass, the other of gutta-percha, the results are as follow:

The bath solution was one which had been considerably worked from, previously to its having been put away. Both baths had been preserved in woollen wrappers, and had been kept during the winter months in an *inside double doored* wine cellar. Data of a bath solution.

When tested for acidity, both were found in the same state, being *just acid.* The pictures taken with that portion kept in glass showed the *best* qualities (see p. 113), those taken *simultaneously* with the other portion were distinguished Comparison of glass and gutta percha.

NITRATE BATH.

by great insensitiveness to the darker portions of the subject, the plates were not clean, long streaming marks, very similar to those in fig. 48, (p. 129), appeared all over the subject, which were capable of removal by friction when the film was dry. The difference of colour by diffused light was great, the one being a bright yellowy drab, the other a dull brick red. On printing from them, the latter was found to be insensitive to the delicate gradations of tone, perfectly delineated by the other. Now the writer conceives that any attempt to *restore* such a bath would be useless, the only thing to do would be to condemn it altogether, and that the same condition, in a modified degree—according to lapse of time,—exists more or less in all bath solution kept, or brought in contact with gutta-percha vessels.

Varied qualities.

Principal derangements.

Apart from contamination by contact with organic substances, and access of light, the principal derangement of the bath is caused by its being in an improper condition of alkalinity or acidity; before commencing operations, its state should always be ascertained by testing, and if found unsatisfactory, corrected as described at pages 120 and 123. It is always advisable to allow a short time to elapse after pouring it out from bottles, or when it has been shaken about in a van, &c., before operating with it. It is a good plan to replace the waste of the bath caused by

Manner of maintaining quantity.

use, with a *plain* solution kept for the purpose, of thirty grains of nitrate of silver to the ounce of distilled water, by which means the bath is kept from being super-iodized by the constant dip of the films (see p. 127). NITRATE OF SILVER.

NITRATE OF SILVER.

Two varieties of this salt are in general use. The cheaper and most extensively used nitrate is prepared by the refiners from their waste liquors, &c., from which formerly the silver was recovered by first converting it into chloride; as met with in the shops, it is in rather small irregular-shaped crystals, having a white effloresced appearance, and being more or less opaque; it is seldom quite pure. NITRATE OF SILVER. Various qualities. Impure.

Pure nitrate of silver is made by dissolving pure silver in nitric acid. On evaporating the solution the salt crystallizes in colourless transparent tables, free from smell of the mother acid; in which state it is to be had in the best shops. The solution of this salt should be neutral to test-paper. This is the kind which should always be used in the preparation of the bath. When nitrate of silver is dissolved in excess of ammonia, the solution should be colourless. As nitrate of silver readily spoils by exposure to light in contact with *organic matter*, great care should be observed in the keeping of this salt, a small fragment of cork, or a little Pure nitrate, its appearances. Precautions for its preservation.

Iodide. lint, from a cloth, being capable of spoiling any quantity.

Treatment of the crystals. Before making bath-solution, it is proper to place the crystals in a *glass* dish, and in a cool oven 200° Fahr, stirring them continually with a glass rod; the effect being to drive off any remains of the mother acid still adhering to them, which would have retarding qualities.

Fused nitrate. The writer has made several trials of fused nitrate, with skilfully prepared samples, for the bath-solution, but has not found them successful in practice, and would recommend the ordinary crystals in preference.

Its mode of preparation. Iodide of Potassium, being prepared by mixing carbonate of potash with iodide of iron, frequently contains a little of the former salt. When pure, it is in crystals of the form of a cube, and causes no precipitate if dissolved in lime-water.

How tested for purity. Distilled Water is tested for purity and freedom from contamination by organic matter, by dissolving in it a crystal or two of nitrate of silver; held in bright light it should remain limpid as before, any cloudiness appearing would show it to be unfit for the preparation of the nitrate bath, &c.

Alcohol is a limpid, colourless, inflammable liquid, having a peculiar and penetrating odour.

Specific gravity. Its specific gravity at 60° Fahr. is 0·7947; at 68° Fahr. it is 0·792. No means of solidifying it are known.

Alcohol has a strong affinity for water; hence it abstracts this fluid from the atmosphere. It is prepared by the chemist from the rectified spirit purchased from the rectifier. It is obtained by adding choride of calcium, carbonate of potash, or well burnt lime, to the spirit which is thus distilled. The salts or lime retain the water whilst the alcohol distils over.

Alcohol. Preparation.

In photography, alcohol is used in several solutions; but, where required to be of the most *absolute purity* is in the additions made to the collodion. Should it contain water, the quality of the film will be thereby greatly deteriorated.

Its uses.

Sulphuric Ether is prepared by the distillation of rectified spirit and sulphuric acid. It is rectified from water, sulphurous acid, &c., by the addition of carbonate of potash and re-distillation. It is a colourless, limpid fluid, having an agreeable fragrance. The ether of the shops contains a little alcohol, and its specific gravity varies from 0.733 to 0.765.

Mode of "washing."

Newly washed for photographic use, its specific gravity at 60°, Fahr. is 0·720 to 0·725, and it should not redden litmus. Pure and recently prepared ether possesses neither acid nor alkaline qualities; but by exposure to light and air, it absorbs oxygen, by which acetic acid and water are produced.

Specific gravity.

The ordinary ether of commerce is contaminated with either spirit or water, or both. Caution

When containing water, &c.

Collodion. must be observed in approaching a candle near the unstoppered bottle, as its vapour is highly inflammable.

Importance in the process.

Collodion.—Much of the success of the photographic manipulation depends on the nature of the collodion employed; the qualities most desirable for it to possess are, that the film laid from it should be even, and free from all reticulations, specks or marks of any kind whatever; that it should flow freely and evenly, that it should be very sensitive to the *obscure* radiations from the subject; whilst the deposit it gives on the highest lights should not be of too great opacity; that it should remain for a considerable period colourless and sensitive.

If in portraiture, and pictures from the life, it is insensitive, the skill of the operator will not avail him, and not only will the expression of the sitter become heavy and unpleasing, from the time necessary to take the picture, but the light and shade will be faulty and disagreeable, and the whole picture unsuccessful. Whilst in copying chalk drawings, prints, and for microscopical and astronomical purposes, if the collodion used is not perfectly structureless and clean in the film it gives and the image it presents, it will be valueless for those uses.

Desirable qualities.

Defects.

It is better to purchase it prepared by those whose sole care it is to procure the necessary

ingredients of undoubted strength and purity, and to give their exclusive care to its preparation. Collodion.

Collodion varies much in its qualities, according as it may have been more or less recently iodized; if intended for portraiture, &c., twelve to twenty-four hours is the best time to use it after iodizing; the qualities it then possesses are—*more sensitiveness* and *less intensity*—which latter is advantageous, since in printing from the resulting negative the light permeates through the highest lights, which are thereby full of forms and gradations of tone. The same state is proper for interiors, instantaneous pictures, and all subjects difficult by their local colours or illumination. Different states.

Landscapes, architecture, exteriors, stereoscopic pictures (being executed with small rapid lenses and requiring extremely clear definition on a diminutive size), still life, statues, &c., will be better treated by collodion in the middle state, which allows longer exposures without fogging, gives greater intensity and clear definition, but necessitates more time than the first. For various purposes.

Whilst chalk drawings, prints, maps, fac-similes of MSS., &c., will be advantageously taken with a sample long iodized and insensitive to half tones, but giving bare glass and intense deposit.

The operator will find appropriate uses for samples in all stages of iodization, and, *if by the same maker,* they may be advantageously combined to meet certain requirements, or by having Mixing.

Toning Bath.

two or even *three* baths in different states of *neutrality*, moderate and greater *acidity*, very excellent pictures will be obtained, since by the skilful and judicious combination of *their* qualities with varying states of collodion the operator may so modify his means as to meet *every requirement* in the manner the most advantageous to the subject undertaken. Caution is required in not approaching too near lights with unstoppered bottles of collodion, its vapour being almost as inflammable as that of ether.

Different baths.

Precautions.

THE TONING BATH.

Formula for solution.

The solution for giving the desired degree of colour to the proofs, is composed in the following proportions.

Clean water	10 ounces.
Hyposulphite of soda . . .	5 ounces.
Chloride of silver . . .	40 grains.
Chloride of gold . . .	10 grains.

Mode of preparing,

Dissolve the hypo in eight ounces of the water, add the chloride of silver, stir well; take a *clean* developing glass, put in it the ten grains of chloride of gold, add the remaining two ounces of water, dissolve, and stir well with a *clean* glass rod, now keeping the first solution in motion by stirring it *briskly*, add the second with a sweeping motion, which shall *at once* intimately mix it with

the hypo (not pouring it in one spot). The sooner it is used the better, indeed, the gold should only be added immediately before it is wanted. Toning Bath.

This solution must be prepared in a deep yellow light, and kept strictly in the dark; when *new*, the above is the formula, afterwards, the chloride of silver will not be needed, being supplied from the proofs, as they are toned in sufficient quantity. When quite freshly prepared, the tones obtained are not agreeable, being too gay and purpling in colour, on further use these will give place to fine deep shades of violet brown, approaching black. and keeping. Desirable colours.

There are several conditions which must be carefully noted as affecting this manipulation. First, the bath must be tested each time before using, and if more than *slightly* acid, it must be corrected with drops of solution of carbonate of soda in distilled water—testing between each addition—until nearly neutral; were it in much excess of acidity, the half tones and delicate markings of the subject would be injured or effaced. Next, on the state of *temperature* depends greatly the time required for toning, varying from ten minutes, at 80°, Fahr., to two hours at 40°, Fahr. Tested for acidity. Affected by temperature.

The lighter parts of the subject are better preserved when the time occupied in toning is not

Toning Bath.

too much prolonged; therefore, in cold weather it is well to raise and keep up the temperature of this solution to 60°.

Expedient for equalizing.

Those who print in large numbers would find a pewter hot water case, communicating with a boiler, on which to place the Wedgewood tray, advantageous; when merely a limited number of proofs are required, the following expedient will be found quite satisfactory. Take a *deep* Wedgewood tray, a size smaller than the one containing the toning solution, fill it with boiling water, and stand the tray with the bath upon it for half an hour before using, the temperature should show an increase of 20° in winter. As has been previously said, the

Continual changes.

fixing bath of hypo gradually becomes a *toning* bath, by the accumulation of the portions of the latter which it acquires, and thus partially or entirely saturated, it is unfitted for its purpose of *clearing the proof from the toning chemicals.*

Mode of operating.

The manner which the writer has found very satisfactory to manipulate this part of the process, is as follows :—have *three* Wedgewood dishes,

No. 1.	No. 2.	No. 3.
The Toning Bath.	The Middle Bath.	Quite clean Hypo fixing.

The proofs having *nearly* acquired the proper tone in No. 1, are passed on to No. 2, when a considerable portion of the yellow colour in the whites is seen to be discharged, whilst the darks acquire cooler tones; having remained according to the temperature, as previously directed, they are to be *passed through* water to remove the solution from their surfaces, and placed in No. 3; here they will be observed to become silvery in the darks and absolutely white. If now they are properly washed, as elsewhere directed, they will be permanent. Solutions. Permanency.

Proofs taken *direct* from No. 1, washed and dried, will fade in a few weeks.

Proofs *passed through* No. 2 may last a few months.

The writer has not known a proof toned and fixed as mentioned, and subsequently *thoroughly* washed, to fade, although many of them are freely exposed to the gases of a London atmosphere. *Various* qualities.

The other advantages of this treatment are, that before No. 1 solution becomes stale, and gives tones deficient in freshness, it is withdrawn and renovated by the continual additions from No. 2, which, in its turn, is improved from No. 3; where entirely *new and clean* hypo is being placed, the *intermediate* bath prevents the fixing from being so quickly contaminated—thus saving trouble and Benefit of *three* solutions.

Solutions. expense—and at the same time is preparing itself to take the place of the toning.

Continual addition of gold necessary.

Between each batch of prints, which should be in small quantities (not more than ten), addition of gold to the bath is necessary, in the ratio of two and a half grains to each twelve by ten print. Manipulate strictly as follows: take one ounce of *new saturated* sol. hypo, add to No. 1,—into two ounces of water put twenty-five grains of chloride of gold—dissolve. Now, stirring as before directed, put in the gold solution, and tone a surface of prints equivalent to ten of 12·10. The *saturated* sol. hypo, balances *the water* introduced with the gold, and the weak additions from the other trays.

How prepared.

Chloride of Gold is produced by dissolving pure gold in nitro-hydrochloric acid. The deep yellow solution thus obtained yields, by evaporation, yellow crystals of the double chloride of gold and hydrogen; when this is cautiously heated, hydrochloric acid is expelled, and the residue, on

Colour of the crystals.

cooling, solidifies to a red crystalline mass of terchloride of gold, very deliquescent, and soluble in water, alcohol, and ether. When pure it is of a very deep orange colour; for photographic use it is better purchased in several *small* well-stoppered

How best preserved.

bottles, containing each from twenty to twenty-five grains, as, if exposed in larger quantities to the atmosphere, it will become deteriorated by

deliquescence, caused by the removal of the stopper. Solutions.

Chloride of Silver is a chalky-looking, white powder, insoluble in water and nitric acid, but soluble with ease in cyanide of potassium, hyposulphite of soda, and ammonia. It is procurable by adding a saturated solution of common salt to a solution of nitrate of silver. It falls as a white, curdy precipitate, which, well washed and dried, is chloride of silver. How soluble.

It is decomposed by light both in a dry and wet state; very slowly if pure, and rapidly if organic matter be present. Decomposed by light.

DEVELOPING SOLUTION

Is prepared in the following proportions: Proportions.

Distilled water.....	1 —	10 —	20 —	40 ounces.
Pyrogallic acid.....	3 —	30 —	60 —	120 grains.
Acetic acid	½ —	5 —	10 —	20 drachms.
Alcohol	⅛ —	1¼ —	2½ —	5 drachms.

Mix the distilled water and the pyrogallic acid, when quite developed filter carefully; *now* add the alcohol and acetic acid. When made in these proportions it keeps better than when prepared of less strength. It is easily diluted as required to meet circumstances of light and temperature. "Three grain" solution.

Solutions.

Light and heat injurious.

It should be kept from the light, and, in summer, in a cellar; in cool weather it will keep a month or more, in summer a week or ten days; a slight discoloration is of no consequence, but if it passes beyond its power of developing slight action on the film is impaired.

How obtained.

Pyrogallic Acid is prepared by heating quickly tannic or gallic acid, previously well dried; it is obtained as a sublimate in white plates or needles, possessing a strong empyreumatic odour and bitter taste. It should not redden litmus, and should not be kept in solution.

Tested.

Glacial unnecessary.

Acetic Acid.—This is seldom really *glacial*, nor is it, indeed, important for the collodion process that it should be so. The presence of a very small quantity of water halves the price of the acid, and is not worth consideration. In its most concentrated form it should be solid at 60°, but when of this strength it is very expensive.

Useless expense.

THE EXCITING SOLUTION

FOR PRINTING,

Is composed of

Solutions.

Nitrate of silver . . .	60 grains.
Distilled water . . .	1 ounce.

If thick papers are used, such as Papier Saxe, eighty grains of nitrate will be required to give good results.

Strength for thick papers.

This solution will in process of use become weaker, and crystals of nitrate must be added to it to keep it up to the requisite strength: it will likewise become discoloured. This, to a certain extent, does not signify, provided the paper excited with it is used at once, as the hypo fixing bath removes such stains from the whites, and leaves them perfectly pure. When more, however, than a mere light brown discoloration has ensued in the solution, it may be removed by the use of "Kaolin," or china clay, which is to be shaken up with the darkened solution, in the proportion of about twenty grains to the ounce of liquid; and it will precipitate the discoloration. The upper portion may then be decanted.

Mode of discolouring.

The reader is cautioned against the use of animal charcoal for this purpose; as on floating

Animal charcoal destructive.

Solutions. albumenized paper in a solution so purified, the albumen detaches itself from the paper, and the result is very damaging to the proofs, which are totally deficient in depth and brilliancy. The horn tongs are to be used in this solution. They keep the hands free from stains and the paper in better condition.

Inferior nitrate. Inferior nitrate of silver is sometimes recommended, as being cheaper, if "*only required for printing.*" If such is used, the permanency of the proofs will certainly be jeopardized. *Pure* nitrate of silver should be employed. It is not necessary that it should be re-crystallized, as for the bath solution.

FIXING SOLUTION.

FOR THE FILM.

Saturated solution. The above is prepared by saturating any desired quantity of water, according to size of the bath, with hyposulphite of soda; that is, until the water will dissolve no more. It will become discoloured by use, which is of no consequence: indeed, it is

Better when used. better when not perfectly new; its action is less violent on the delicate parts of the deposit.

FIXING SOLUTION (for printing) is prepared in the following proportions:— SOLUTIONS.

Filtered water . . .	15 ounces.
Hyposulphite of soda . .	½ lb., Avoirdupois.

HYPOSULPHITE OF SODA is made by digesting sulphite of soda on flowers of sulphur, at a high temperature. It occurs in white, transparent crystals, and is *very variable* in quality. When good, it should dissolve one half of its weight of iodine; and its solution should give no precipitate with a soluble salt of strontia or lime. Mode of preparation. Test of goodness.

FRENCH DECIMAL WEIGHTS.							ENGLISH WEIGHTS.							
							Equiv. in Troy weight.				Equiv. in Avoirdupois weight.			
Kilogramme.	Hectogramme.	Decagramme.	Gramme.	Decigramme.	Centigramme.	Milligramme.	lbs.	oz.	dms.	qrs.	lbs.	oz.	Troy grs.	Equiv. in Troy grs.
...	...	...	...	...	...	1	...	...	...	...	...	...	...	·0154
...	...	...	...	...	1	10	...	...	...	...	...	...	...	·1543
...	...	...	...	1	10	100	...	...	...	1·5	...	...	1·5	1·5432
...	...	...	1	10	100	1000	...	...	...	15.4	...	. .	15·4	15·432
...	...	1	10	100	1000	10,00	...	...	2	34	...	...	154·0	154·323
...	1	10	100	1000	10,000	100,000	...	3	1	43	...	3	230·7	1543·234
1	10	100	1000	10,000	100,000	1,000,000	2	8	1	12	2	3	119·8	15432·348

WEIGHTS AND MEASURES.

TROY WEIGHT.

1 grain.								
20	=	1 scruple.						
60	=	3	=	1 drachm.				
480	=	24	=	8	=	1 ounce.		
5760	=	288	=	96	=	12	=	1 pound.

FLUID MEASURE.

1 minim.						
60	=	1 fluid drachm.				
480	=	8	=	1 fluid ounce.		
9600	=	160	=	20	=	1 pint.

PARALLEL OF ENGLISH AND FRENCH MEASURES.

French litres.		
4·5455	=	1 gallon.
0·5682	=	1 pint = 20 fluid ounces.
0·2841	=	1 fluid ounce.
0·0355	=	1 fluid drachm.
1·000	=	0·22 gallon. 1·76 pint.
0·001 centimetre cube	=	15·4 grains of water, at 62° Fahr.

INDEX.

Aberration, spherical, 28; chromatic, 35.
Accessories, how arranged, 145.
Acetic acid, 121.
Acidity of bath, 123.
Actinism illustrated, 18.
"Adapters," 69.
Albumen, 213.
Alcohol, 234.
Alkalinity of bath, 120.
Amber varnish, 118.
Angle of light on sitter, 61.
Animal charcoal, 245.
Animals, modes of photographing, 180.
Animation in portraiture, 146.
Architecture offers, facilities, 173; subjects, 174.
Area, in the eye and the camera, 28; defects of large, 29; of aperture, importance of, 55.
Aspect of glass studio, 58.
Atmosphere acted on by light, 37.

Backgrounds, 143.
Bassi-relievi, 186.
Baths, glass, advantageous, 86.
Bath, nitrate, 238.
Blinds for diminishing light, 61.
Bottles, various, 90; cleansed, 228.
Box, operating, described, 171.
Bronzes, 187.
Busts, 184.

Camera, action compared with the eye, 26; portrait and landscape, described, 69; test for, 70.
Camera stands, 73.
Chirurgery, photographic delineations of, 183.
Cleanliness, chemical, 65.
Coincidence of foci, its nature and action, 36.
Comets, 127, 128.
Collodion, viscous, 124; qualities and defects, 236; mixing, 237.
Colour, result of dispersion of light, 13; varieties in negatives, 113.
Colours for walls of studio, 62.

Defects, 119.
Definition, 44.
Developing, stand, 84; glasses, 88; the image, 107.
Development, 107.
Diaphragms, nature of, 47; holder, 49.
Dimensions for portraits, 160.
Dippers, silver-wire, 82.
Distortion, 148.
Drawings, copies from chalk, 192.

Ether, sulphuric, 235.
Exciting tray, 94; the film, 101.
Exposing the film, 103.
Exposure, time of, 104.
Eye, the, action imitated by the camera, description of, 21; piece focusing, 95.

Fac-similes of manuscripts, books, &c., 194.
Filtering papers, 96.
Fixing, the negative, 115; bath, 224.
Focus, depth of, 41, 45; importance in portraiture, 147.
"Fogging," 109, 120.
Funnels, 88.

Glasses, 79; mode of cleaning, 80.
Gold, chloride of, 242.
Graduated glass measures, 88.
Groups, in the studio, 150; radii, 157.
Gutta percha, trays, 87; mode of cleansing baths, 231.

Head rests, 77.
Horn tongs, 90.
Hyposulphite of soda, 247.

Instantaneous pictures, 160; subjects for, 161.
Intensity of the image, 110.
Interiors, 203.

Kaolin, 245.

Landscapes, 166.
Laying the film, 98.
Lead acted upon by the chemicals, 66.
Lenses, non-coincident, 36; coincident in foci, 38; various, for different uses, 39; dimensions, 40; definition of, 41; test of qualities, 42; slow, how caused, 46; double, 56; flat in field, 147.
Light, sources of, 11; reflexion of regular and irregular, 12; intensity, 12; refraction of, 14; dispersion, 15; absorption of, 19; diffused, 133, 219.
Linen cloths, 95.

Manipulations, 97.
Marine subjects, 178.

Marks, of drainage, 131; of slide, 132.
Mezzotints, to copy, 193.
Microscopic subjects, 206.

Negative, to print from, in direct sun, 218; by diffused light, 219.
Nitrate bath, 227; formula for, 229; testing, 230; data respecting, 231.
Nitrate of silver, 233; fused, 234.

Operating room described, 64.
Over-exposure, 107, 122.

Paper, 210; albumenized, 211; plain salted, 214; to excite, 215.
Parallel of the action of the eye and camera, 26.
Pathology, subjects relating to, 182.
Photography, astronomical, 205.
Pictures, copies from, 189; stereoscopic, 195; various treatments, 198.
Plate holders, pneumatic, 85.
Portraits, 137; heads only, 138; full-length, 139; three-quarter, 139; conditions for portraiture, 143.
Printing, frames, 93; processes, 209.
Prints, copies of, 192.
Proofs, permanency of, 241.

Rapidity of lens, 138.
Rays, visual, not photogenic, 19; oblique and parallel, 37.
Reflectors, various, 149, 153.
Reflexion, 133, 188; to guard against, 191.
Retort stand, 89.
Rustic figures, mode of treating, 157.

Scale for apertures, 56.
Scales, 83.
Silver, deficient in film, 134; chloride of, 243.

Sketches recommended, 141.
Solutions, for plain salted paper, 214; toning, 238; developing, 243; exciting, 245; fixing (for the film), 246; fixing (for printing), 247.
Specific-gravity bottle, 85.
Spectrum, solar, its nature, 15, 19.
Spirit lamp, 93.
Spirit level, its use, 84.
Spoons, glass, 88.
Spots, of transparency, 126; of opacity, 127.
Stains, serrated, 125, 129; of development, 133.
Statues, 185.
Still-life, 187.
Still, 92.
Studio glass described, 57.
Sun-printing, 218.
Swing camera back, 74.

Taste, cultivation of, 173.
Temperature, modes of equalising, 62, 240; exciting, 102; effect of, on exposing, 105; developing, 107; albumenizing, 212; toning, 239.
Test papers, 96.
Thermometers, 89.
Toning process, 222; bath, formula, 238.

Under-exposure, 106, 109, 123.

Varnish, yellow, detrimental in copying, 189.
Varnishing the picture, 116, 117.
Ventilator, Arnott's, 64.
Vernis Soehnée, 118.

Washing, glasses, 80; prints, 225.
Wash-leathers, to prepare, 95.
Waviness, 123.

Wedgewood trays, 87.
Weights and Measures, English and French, 248, 249.
White light, effects of, 66.
White rings, 125.

THE END.

PRINTED BY J. E. ADLARD, BARTHOLOMEW CLOSE.

A

LIST OF BOOKS

PUBLISHED BY

JOHN CHURCHILL,

NEW BURLINGTON STREET.

MR. BEASLEY'S WORKS.

I.

THE DRUGGIST'S GENERAL RECEIPT-BOOK; comprising a copious Veterinary Formulary and Table of Veterinary Materia Medica; Patent and Proprietary Medicines, Druggist's Nostrums, &c.; Perfumery, Skin Cosmetics, Hair Cosmetics, and Teeth Cosmetics; Beverages, Dietetic Articles, and Condiments; Trade Chemicals, Miscellaneous Preparations and Compounds used in the Arts, &c.; with useful Memoranda and Tables.

Fourth Edition, 24mo, cloth, 6*s*.

II.

THE BOOK OF PRESCRIPTIONS; containing 2900 Prescriptions. Collected from the Practice of the most eminent Physicians and Surgeons, English and Foreign.

24mo, cloth, 6*s*.

III.

THE POCKET FORMULARY AND SYNOPSIS OF THE BRITISH AND FOREIGN PHARMACOPŒIAS; comprising standard and approved Formulæ for the Preparations and Compounds employed in Medical Practice.

Sixth Edition, revised and enlarged, 24mo. cloth, 6*s*.

The THIRD EDITION, greatly enlarged, 1350 pages, 8vo, cloth, 26*s.*

The Cyclopædia

OF

PRACTICAL RECEIPTS,

AND

COLLATERAL INFORMATION IN THE ARTS, PROFESSIONS, MANUFACTURES, AND TRADES:

By ARNOLD J. COOLEY.

From the City Article of the 'TIMES' *Newspaper, March* 12*th.*

"Among recent commercial publications has been a Third Edition of 'THE CYCLOPÆDIA OF PRACTICAL RECEIPTS,' by Mr. Arnold J. Cooley, an elaborate work, well known to persons engaged in Arts and Manufactures, as furnishing a condensation from time to time of the vast mass of additional information constantly obtained by the progress of experience in all industrial processes. It describes not only the leading properties of the various substances converted to human use, but also the latest and most economical modes of manipulation, whether in the factory, the laboratory, or the household. The present edition is stated to have been entirely re-written, and remarkable care seems to have been bestowed to render the explanation of each formula or process clear and worthy of confidence."

ELEMENTS of NATURAL PHILOSOPHY; being an Experimental Introduction to the Study of the Physical Sciences. By GOLDING BIRD, M.D., F.R.S., and CHARLES BROOK, F.R.S. Fourth Edition, with numerous Engravings on Wood, fcap 8vo, cloth, 12*s.* 6*d.*

"This work marks an advance which has long been wanting in our system of instruction. Dr. Bird has succeeded in producing an elementary work of great merit."—*Athenæum.*

"We should like to know that Dr. Bird's book was associated with every girls' and boys' school throughout the kingdom."—*Medical Gazette.*

"A volume of useful and beautiful instruction for the young."—*Literary Gazette.*

Foolscap 8vo, 2*s.* 6*d.*

A CATECHISM of the PHYSIOLOGY and PHILOSOPHY of BODY, SENSE, and MIND. For use in Schools and Colleges, and in Private Study. By T. WHARTON JONES, F.R.S., late Fullerian Professor of Physiology in the Royal Institution of Great Britain, &c.

THE MICROSCOPE and its REVELATIONS. With numerous Engravings on Wood. By W. B. CARPENTER, F.R.S. Second Edition, fcap 8vo, cloth, 12*s.* 6*d.*

ON WINE.

By G. J. MULDER,

Professor of Chemistry in the University of Utrecht.

Edited by H. BENCE JONES, M.D., F.R.S.

Fcap. 8vo, cloth, 6*s.*

CONTENTS:

On the Grape.
On the Fermentation of Grape-Juice.
On the Clearing of Wine.
On the Sulphurizing of Wine.
On the Cellaring of Wine.
On the Diseases of Wine.
On the Constituents of Wine.
On the Amount of Alcohol in Wine.
On the Tannic Acid in Wine.
On the Colouring Matters of Wine.
On the Iron in Wine.
On the Fatty Matter in Wine.
On the Free Acids in Wine.
On the Malic, Citric, and Racemic Acids in Wine.
On the Glucic Acids in Wine.
On the Formic and Lactic Acids in Wine.
On the Albuminous Matter in Wine.
On the Ammonia or Ammoniacal Salts in Wine.
On the Sugar in Wine.
On the Non-Volatile Constituents of Wine.
On the Incombustible Constituents of Wine.
On the Odoriferous Constituents of Wine.
On the Analysis of Wine.
On the Tests for different Wines.
On the Adulteration of Wine.
On Fruit Wines.

WORKS ON CHEMISTRY.

BY ROBERT GALLOWAY, F.C.S.,

Professor of Practical Chemistry in the Museum of Irish Industry.

I.

THE FIRST STEP IN CHEMISTRY. Second Edition. Fcap 8vo, cloth, 5*s*.

II.

CHEMICAL DIAGRAMS, on Four Large Sheets, for Schools and Lecture Rooms. Price 5*s*. 6*d*. the Set.

III.

A MANUAL OF QUALITATIVE ANALYSIS. Second Edition. Post 8vo, cloth, 4*s*. 6*d*.

CHURCHILL'S MANUALS.

Fcap 8vo, cloth, 12*s*. 6*d*. each vol.

Aggregate Sale, 91,000 *Copies*.

ANATOMY. Mr. ERASMUS WILSON.
CHEMISTRY. Mr. FOWNES.
MATERIA MEDICA. Dr. ROYLE.
MEDICINE. Dr. BARLOW.
MEDICAL JURISPRUDENCE. Dr. TAYLOR.
MICROSCOPE. Dr. CARPENTER.
NATURAL PHILOSOPHY. Dr. G. BIRD, and Mr. BROOK.
OPHTHALMIC MEDICINE. Mr. WHARTON JONES.
PATHOLOGICAL ANATOMY. Dr. H. JONES, and Dr. SIEVERKING.
PHYSIOLOGY. Dr. CARPENTER.
POISONS. Dr. TAYLOR.
SURGERY. Mr. FERGUSSON.

John Churchill, New Burlington Street.

574

85-B7789

2/84
HML=
6449

GETTY CENTER LIBRARY
3 3125 00952 0111

BOUND BY
EDMONDS & REMNANTS
LONDON